AVIATION

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New York, N. Y.

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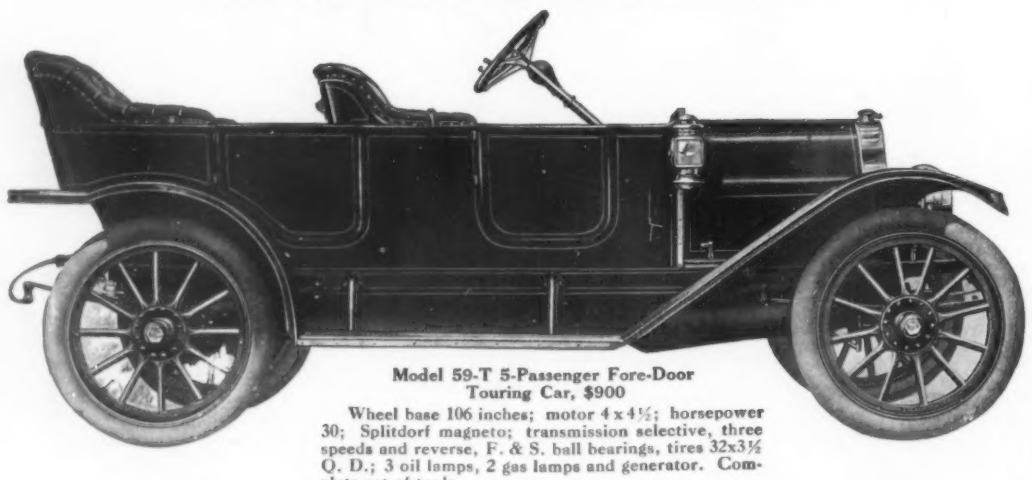

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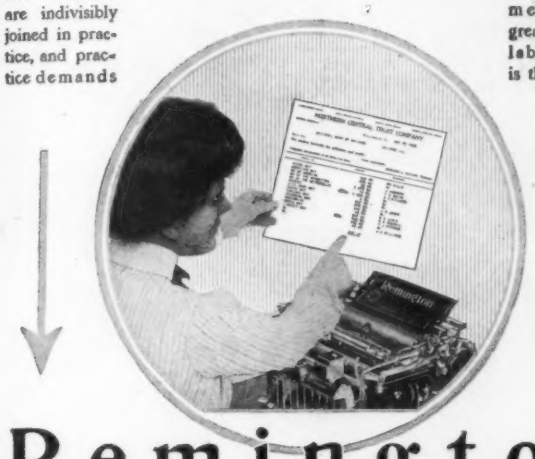

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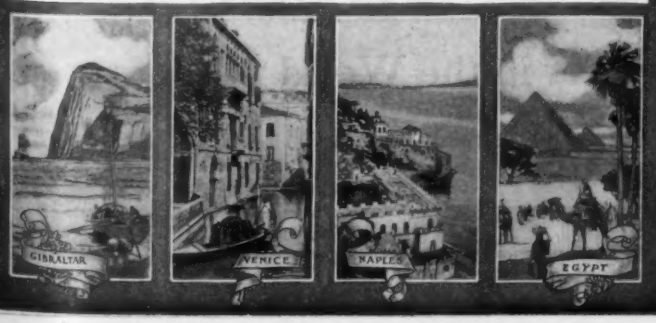

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SIXTY-SEVENTH YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CV. NUMBER 16.] NEW YORK, OCTOBER 14, 1911 [15 CENTS $3.00 A YEAR

View from below dam, showing huge sections of the wall pushed bodily down stream.

The Failure of the Austin Dam

A Call for State Legislative Control

THE complete failure of the Austin dam, with its resultant loss of property and human life, has naturally drawn attention to the early history of this structure. The dam was constructed in the year 1909, to replace a smaller dam higher up stream built about eleven years previously, for the purpose of impounding the water required for a pulp mill. The width of the valley at the point where the new dam was placed is 350 feet, and the reservoir was designed to impound 200,000,000 gallons of water, with the spillway 42 feet above the level of the valley. The width of the dam at the top was 2 feet 5 inches, at the bottom 30 feet. The length of its upper face was 544 feet. The rock foundation of the valley consists of horizontal layers of sandstone with shale sandwiched in between. The building of the dam, which contained about 16,000 cubic yards of concrete, was begun in May and completed about December 1st, 1909. In preparing the foundations, about 8,000 cubic yards were excavated, and an earth embankment was laid against the upstream face of the dam at a slope of 3 : 1, reaching within 27 feet of the normal water level.

The concrete structure was reinforced with twisted steel rods 1¼ inches in diameter and 25 feet long, placed 2.7 feet apart. On either side of the spillway a pilaster was built, which also was reinforced with half-inch steel rods, as was the top of the dam. Very significant is the fact that, upon completion of the dam, there was found to be a crack extending from the top to the ground level, and in December, 1909, a second crack appeared. About January 17th, 1910, the weather was warm, and abundant rain fell. On the 21st of January, the dam was overflowing. On Sunday, the 22nd, water was found to be leaking from the toe of the dam. It was suggested at the time that the failure of the dam to withstand the flood of 1910 was due to two causes. First, the great bulk of the hurriedly built concrete, some of which was laid in freezing weather, and completed only six weeks before the time when the maximum pressure occurred; secondly, the seepage of water through the rock strata under the dam.

As far as we can learn, the work done upon the dam at this time in the way of investigation of conditions and of provision against further damage, was altogether inadequate, particularly in view of the fact that heavy seepage had taken place through the porous material below the foundation. The least that could have been done would have been to sink a curtain wall through the underlying rock, etc., carrying it down everywhere to a thoroughly impervious stratum. Failing this, the dam should have been abandoned altogether.

In the construction of storage dams, of whatever character, it is an axiom that there should be no suspicion whatever as to the impermeability, not merely of the dam itself, but of the natural formation upon which it is laid. There is no mystery about the construction of watertight dams. The problems connected with their foundations and with the stresses in the dams themselves are perfectly well understood among competent engineers, and have been so understood for a long period of time. We know of no engineering work regarding which the possibilities of failure are so many, and their results so serious, as that which has to deal with the impounding of vast quantities of water by the erection of artificial barriers. Thanks to accumulated stores of knowledge, and to the very thorough training, theoretical and practical, to which the competent civil engineer is subjected, both at the engineering schools and colleges and in his subsequent career, there is abundance of high class professional skill available for those individuals or corporations who wish to undertake the construction of works of this character.

One of the most important lessons of this disaster is that which teaches the necessity for the employment of engineers skilled in this particular branch of work. Another lesson is that when the engineer has been engaged, he should be left an absolutely free hand in determining the character of the construction that should be employed. To engage an engineer to design a dam of importance and then impose a limit of cost is to tempt him to play fast and loose with the ethics of his profession, and imperil the safety of the proposed structure.

The photographs of the wrecked dam and the devastation which was caused by the flood of water that swept through the valley below tell their own story so clearly that but little comment is necessary. If we bear in mind that seepage was occurring below the foundation, the probable sequence of events, as the dam gave way, is easy to understand. We spoke early in the present article of certain cracks that appeared when the dam was first filled with water. Very significant is the fact that one of the largest breaks in the dam wall occurred along the very lines of these old fractures. Settlement due to gradual washing out of the underlying porous material, coupled with changes of temperature, may have induced the original cracks. Further washing out below the foundations would cause these cracks to become complete lines of cleavage. Then it was that the loss of transverse

(Continued on page 336.)

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

Mind and Mechanism

IT has been pointed out that the mechanical aids which man has devised to assist him in his varied pursuits of daily life are subject to an evolution precisely similar in character to that which governs the development of living organisms. In this evolution of our mechanical adjuncts there is a tendency to transfer to them a greater and greater share of the functions originally performed by man himself. Thus the rude implements of primitive man, the cudgel, the stone hammer, may be regarded as a modified arm, a fist remodeled to adapt it to a special end. The energy for the action of such simple tools is supplied directly by the operator, without undergoing any fundamental modification on its way to the point of application. Later came levers, engines of war, and various instruments of more complicated character. Here the energy is in most cases still derived from the primitive source, the human body, but its factors undergo various changes, as in the lever, which, by lengthening the path of travel of the point of application, secures a proportionate gain in the mechanical power available—or in the crossbow, which stores up in the form of elastic strain the work done by the muscles of the arm. This pent up energy, when suddenly released by the action of the trigger, speeds the deadly missile at the foe. The bowman, having in a separate act charged his weapon with the strength of his arm, is, in the second stage of the process, free to give his whole attention to the aim.

But man early found means to supplement the limited powers of his body from more lavish sources —the wind, the running stream, were pressed into his service. Then came explosives, and last of all the patient steam engine. And now becomes apparent a new feature. The new servant does more than merely replace the hand, the arm, or the feet that carry us from place to place. The inventor has, as it were, breathed into his creature a part of his own sentient soul. In orderly sequence, and with a precision that defies imitation by human hands, a legion of tireless engines in the factories throughout our land perform innumerable tasks that seem to require the guidance of a reasoning mind. The co-ordination centers of the inventor's brain have, as it were, been implanted in the machine. Nor is this all. Such purely mental a task as numerical computation is now intrusted, with great saving of time and brain-fatigue, to the mechanical calculator. Indeed, a machine has been built, which, when given the premises of a problem, will, by purely mechanical manipulation, complete the argument and set forth the logical conclusion. This "logical machine," it is true, is at the present time but a scientific curiosity and perhaps will always remain so.

Coming right down to current events, a most instructive and interesting case is presented to us in the Doutre aeroplane stabilizer recently described in our columns. The action of this apparatus displays all the characteristic features of the "sensory motor circuit" of psychology. Throughout all the interactions of the individual with the external world there runs a cycle. The first link in the chain is, as a rule, a stimulus from outside, causing a "sense impression" in some one or other of our organs of special sense, such as the eye, the ear, or the tactile papillæ of the skin. Occasionally an "internal sense" such as our sense of orientation or equilibration may take the place of our consciousness of things without. In the last stage the cycle returns again to the external world, the action being now reversed, the organism reacting upon its environments. Intermediate between these two stages there is necessarily a connecting process, which may be intensely complicated, involving all the intricacy of a long chain of mental operations; in other cases the connection is at least seemingly simple. The sensory motor circuit appears most clearly in so-called reflex actions, for here the successive steps occur in immediate sequence. Thus a sudden loud report produces an instant quiver of the eye-lid; if through some accident the balance of our body is upset, reflex action, through the medium of our sense of equilibrium, located in the semi-circular canals of the inner ear, immediately calls out a righting motion in the requisite muscles. Consciousness does not necessarily enter into these effects, which, indeed, continue during the lighter stages of anæsthesia, but, as has already been indicated, conscious action is subject to the same cycle. This is obvious enough when the reaction follows close upon the stimulus, as, for instance, when the sight of some desirable object induces us to put forth our hand and seize it. But in the great majority of cases, in the infinite variety of our daily activities, the reaction is "delayed" and many complicated steps of mental and emotional experience intervene between the data furnished by our senses and the action based upon them. But however complex these data may be, involving often the entire previous history of the individual; however intricate the maze through which the mind weaves its thread from the entrance to the soul, a sense perception, to the final goal, the reaction upon the environment: the same sensory motor circuit is discernible throughout. For all the contents of our mind are ultimately referable to sense impressions.

The Doutre stabilizer is equipped with an anemometer plate which responds to variations in pressure, thus, as it were, informing the apparatus of external conditions, just as our eye, our ear, our sense of touch, keep us informed of the state of the world around us. More than this, by a suitable mechanical connection, the stimulus thus applied to the anemometer, by relay action, sets free a store of energy which actuates an auxiliary motor. This reacts upon the environment in such a way as to preserve the aeroplane from accident. Furthermore, the Doutre stabilizer comprises an element which is the exact counterpart of some of our internal senses. The apparatus reacts not only to changes in external conditions, but also to changes of its own speed. A number of gliding weights are partially free to move relatively to the body of the aeroplane. According to the laws of dynamics, they will do so, owing to their inertia, as soon as the aeroplane suffers an acceleration. The relative motion of the gliding weights with reference to the body of the aeroplane is made to actuate the auxiliary motor, and again we have an exact counterpart of reflex action, designed to maintain the "life" of the machine.

Had the inventor set to work with the deliberate intention of preparing a mechanical model illustrating reflex action, he could hardly have produced a more perfect example than is presented to us in the Doutre stabilizer.

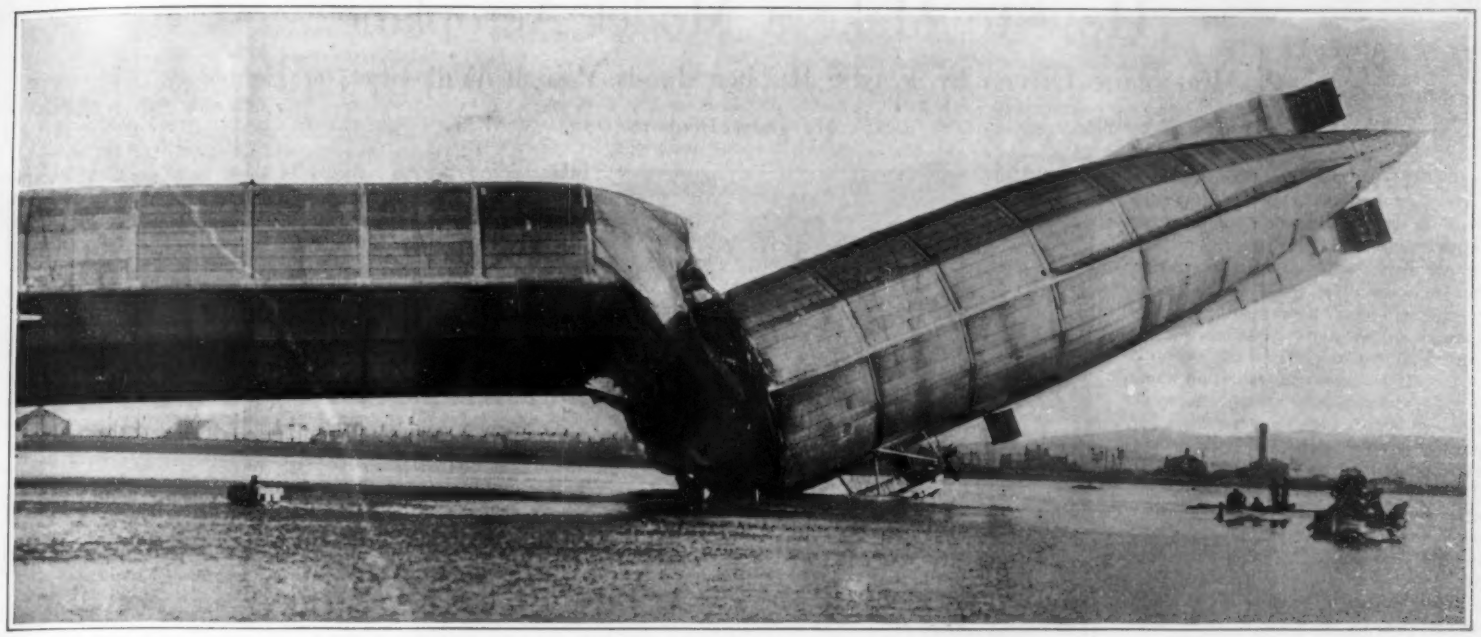
New York's Budget Exhibit

THE necessity for technical men and scientific methods in the administration of the modern city is one of the most impressive lessons to be derived from the Budget Exhibit now being held in the city of New York for the information and instruction of its taxpayers. Taking place in October at a time when the annual discussion of the city's appropriations for the ensuing year is in progress, this exhibition supplies a full and illustrated record of the activities of the municipality. Like any large private corporation, a city requires efficiency of management and systematic cost accounting just as if it were concerned with manufacturing or transportation; but on account of political conditions, charter and other legislation, and, even more largely, lack of interest and dense ignorance on the part of the citizen stockholders, municipal efficiency and economy are more difficult of realization. However, they are the keynotes of all practical municipal administration no less than of the successful conduct of industrial operations, and to the interested taxpayer in such a city as New York they figure prominently at the time of the adoption of the annual budget by the Board of Estimate. To this body must come the heads of all the city departments, with their requests for appropriations for the ensuing year properly analyzed and classified, and with a record of work accomplished under previous appropriations. To secure the appropriations asked for, the department heads must convince the Board of Estimate and the taxpayers of the city that their estimates are reasonable and the record of their work such as to warrant the desired appropriation, or as much thereof as the best interests of the city will permit.

To get the greatest publicity for these different departmental statements, which in 1910 included the eighteen hundred items that went to make up a $174,000,000 budget, the city of New York for two years past has hired an unoccupied mercantile building on Broadway, where are displayed such charts, diagrams, photographs, and appropriate objects as best illustrate the needs and work of each department, bureau or office. In many cases, such as departments of law and finance, the exhibit is merely statistical or a summary; but in others there are displayed photographs, specimens, apparatus, or machinery which show the application of modern science and engineering to municipal problems and conditions, and the resulting increase in efficiency and economy by the adoption of recent inventions and improved scientific methods. For example, child hygiene, and food and milk inspection are items calling this year for largely increased estimates by the Health Department. At the Budget Exhibit can be seen charts showing what has already been accomplished along these lines together with statements of what is desired. To give point to this there are shown actual photographs contrasting wholesome conditions with those which give rise to disease; also the various physicians, nurses, inspectors and other officials of the department are portrayed at work in schools, tenements, milk stations, and even at the farms. To support the demand of the Fire Commissioner for appropriations for new motor apparatus, there may be seen at the exhibition a high-power gasoline pumping engine, that has recently passed the rigorous requirements of the department engineers, and a modern motor hose wagon temporarily withdrawn from active service. Interesting as these are as engineering novelties, it is in connection with their surprising economy that they find place in the budget exhibit, eliminating as they do the more expensive fire horse, an honored specimen of which is stabled hardby the new apparatus. The best methods of fire-proof construction and fire prevention, soon to be enforced by a new Bureau of Fire Prevention, are also shown.

The Department of Docks and Ferries by plans, photographs and models shows its comprehensive schemes for developing and increasing the water front to provide much needed facilities for commerce. The Department of Water Supply, Gas and Electricity shows the various devices used in the distribution and measurement of water, with some interesting relief maps by which the history of water supply and distribution is shown from the time of the settlement of the city. The progress of the great Catskill Aqueduct is also graphically illustrated by photographs and models, and a comparison is made with previous supply systems.

These few instances are but typical of the many exhibits, both graphic and practical, that make up this most interesting display; but they like others serve to emphasize that close connection between municipal economy and scientific work which is not always realized outside the ranks of municipal engineering. If the lives of the poor and particularly of infants are properly to be safeguarded the testing of milk and food must be done in the laboratory and standards adopted for the inspectors. Improved fire apparatus must be supplied, if adequate protection is to be furnished to buildings that are ever increasing in number, volume and height. New docks for the commerce of the future and to produce revenue for the city must show the best civil engineering of the day. These projects, illustrated and described, do, or should, represent the best engineering of the time. And the citizen who examines the vast budget of the city for its current expenses as well as the bonds issued for permanent improvement, must have the conclusion forced upon him that it is the engineer rather than the politician who should be primarily responsible for conducting the affairs of a great city, at least if efficiency and economy are to be secured. Even under present conditions the part played by the former is greater than many would suspect. It is the engineer, the architect, the sanitarian, the physician, the landscape gardener and other workers of applied science that make our cities. Their influence equals, if it does not surpass that of our legislators and politicians. This fact is impressed strongly upon every understanding visitor to the Budget exhibition.



The "Mayfly" directly after the accident. Only one compartment deflated.

Wreck of the British Naval Airship "Mayfly"

Penalty of Launching a Rigid Dirigible in a Cross Wind

By Carl Dienstbach

RATHER a striking contrast is offered by the pitiful wrecking of the first non-German rigid dirigible, the British naval airship "Mayfly," which broke in two before it even got into the air, and the many excellent performances of Count Zeppelin's new "Schwaben," which at last completely fulfills what the advocates of the rigid system and of the mammoth dirigible so long promised seemingly in vain. When the British ship first came out, it claimed a considerable advance over the Zeppelins, but before its trials could begin in earnest, even its claimed superiority had been far surpassed by the "Schwaben's" actual performances. Its ultimate fate seems to offer a striking object lesson of the fallacy of judging the merits and demerits of a theory from isolated experiences.

It is interesting to try analyzing the causes of this accident from the point of view of the Zeppelin practice. It must be pointed out as a fundamental mistake for an airship to be taken on water from a stationary shed on land in side wind, even though a light one. In 1906 Zeppelin and his engineers had much yet to learn, but even then they were careful to avoid taking the "Zeppelin II." from its stationary shed on the shore of Lake Constance, near Manzell, when the slightest wind was blowing across the entrance. The number of trials that season was much limited on that account, but no exception was made to the rule. It is difficult to hold an airship against lateral wind pressures, and the cars floating on the water and partly submerged cannot yield to a gust as quickly as over land. For this reason the principal Zeppelin sheds on the lake were floating structures, which always swing automatically into the direction of the wind.

Much light is further shed on the naval dirigible's misfortune if we recall that the first frame attempted by its builders was avowedly a complete failure, and that right before the first "coming out" of the ship there had been trouble from the tearing and leaking of the internal gas bags. The first picture of the accident shows the damage all confined to one compartment, and it is reported that the accident originated with the tearing of the gas bag contained in this compartment. The simplest consideration shows how very much the structure of a rigid dirigible is weakened if one compartment near its center should suddenly be deflated. It is a fundamental fact that the solidity of a rigid dirigible results chiefly from aerostatic pressure of the gas in its different compartments. The frame of the first "Zeppelins" partly collapsed over night, when there was no gas in the ship, and some of the ropes by which it was suspended from the ceiling of its shed gave way for some unexplained reason. But if the whole hull represents two halves with gas in each, the case is worse. All the leverage of the lift in these halves is then exerted against the framing of that single compartment, the weight of each car acting as a fulcrum. If there were gas in it, this compartment would not only compensate the strain to a certain extent by its own lift, but furthermore, the pressure of the gas sideways, against the flat ends of the cylinder formed by its gas bag, would most strongly brace it against exactly the kind of strain it encounters. At the point where the strain tries hardest to crush the longitudinal members by compression, namely, along the top, the side pressure of the gas is strongest. One needs but to recall the appearance of an ordinary spherical balloon immediately after inflation. Every rope has then been "frozen" into a rigid bar, and the ordinary rules of architecture are in a way exactly reversed, for everything is pushing up and trying to "flare" toward the top. In a rigid airship the compression strength of the many single members of the frame becomes all powerful if it is aided by this force. Without the gas lift, a member of a rigid frame is strictly "rigid" only for a certain limited distance, as is so well shown in the sad collapse of the naval dirigible's body shown in the second picture, after deflation. Indeed, the frame of a rigid airship should by no means be so weak in itself as to break if a single central compartment should become deflated. The incident on the "Zeppelin III.'s" trip to Berlin, 1909, when the flying blades of a burst propeller pierced the hull, without causing an accident, shows how much resistance it may offer.

The "Mayfly" some time after the accident. Many compartments deflated and lifting power lost.

How to Make a Model Aeroplane

A Monoplane Driven by Elastic Rubber Bands Which Will Fly 700 Feet

By Cecil Peoli

AFTER the problems of flight had been so far solved that men could take the air with reasonable safety, it was but natural that boys, who like everything that "goes," should take an interest in the flying machine. It is not too much to say that most boys from twelve to eighteen know more about the actual construction of aeroplanes and the difficulties of building and operating them than their grown-up relatives, who stand open-mouthed in the contemplation of spiral dips, figure-of-eight curves, and other antics.

The interest of boys in aeroplanes has led them to build small models of their own. With these, remarkable results are obtained, so remarkable indeed that in the hands of a skillful scientific experimenter, they might be used for the purpose of clearing up some of those mysteries of dynamic flight which are still concealed. Although the results obtained with small models are not always directly transferable to the full-sized machine, there can be no doubt that they will serve the useful purpose of performing at a small expense, in a rough yet sufficiently accurate way, the work which is now being done by costly aerodynamic institutions.

Feats Accomplished With Small Models.

The rivalry among boys in the building of safe, stable models is so keen that model-flying contests are held from time to time in various parts of the country, notably at Van Cortlandt Park, New York city. The amount of interest that is aroused is impressive to the man who is unfamiliar with the spread of the model-making movement among boys. The feats accomplished by the models are indeed remarkable. One of them, devised by the writer of this article, has flown for a distance of 1,691 feet, driven only by rubber bands. The model which is here illustrated, is built along somewhat similar lines, and will fly for about 700 feet. A boy of an experimental turn of mind can supply it with supporting surfaces of different size and shape, and probably increase its flying range considerably. At all events, the possibilities for experimenting, if the boy who makes this aeroplane is of an inquiring turn, are almost unlimited.

Aeroplane models are sold in stores throughout the country. They undoubtedly fly—some better than others. Their cost ranges from two to five dollars, and upward. The model here shown can be made for much less and will outfly almost any bought model.

The Main Frame.

The main frame of the model monoplane consists of two strips *a* of spruce, each 28 inches long, and measuring in cross section ¼ by ⅜ of an inch. As shown in Fig. 1, the two strips *a* are tied together at the front and with strong thread and are then glued, the glue being spread over and between the windings of the thread. (Figs. 1 and 5.) The rear ends of the two strips *a* are spread apart 4¼ inches to form a stout triangular frame, and are tied together by cross bars of bamboo *b* and *c*, which are secured to the main strips *a* by strong thread and glue.

The Propellers.

The propellers *d* are two in number and are carried by the two long strips *a*. Each propeller is five inches in diameter, and is whittled out of a single block of white pine. The propellers have a pitch of about ten inches. After the whittling is done they are sand-papered and coated with varnish. The thickness of the wood at the hub (*e'*, Fig. 7) of the propeller should be about ⅝ of an inch. At the rear ends of the strips *a* bearing blocks *e* are secured. These bearing blocks are simply small pieces of wood projecting about ⅝ of an inch laterally from the strips *a*. They are drilled to receive a small metal tube *f'* (steel, brass or copper), through which tube the propeller shaft *f* passes.

The propeller shaft itself consists of a piece of steel wire passing through the propeller hub and bent over the wood, so that it cannot turn independently of the propeller. Any other expedient for causing the propeller to turn with the shaft may obviously be employed. Small metal washers f^2, at least three in number, are slipped over the propeller shaft so as to lie between the propeller and the bearing block.

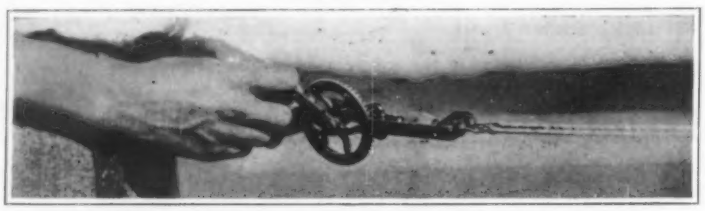
That portion of the propeller shaft which projects forwardly through the bearing block *e* is bent to form a hook f^3. To the hook *f* rubber strips *h*, by which the propellers are driven, are secured. The rubber strips are nearly as long as the main strips *a*. At their forward ends they are secured to a fastening consisting of a double hook *k l*. The hook *k* lies in a horizontal plane, the hook *l* in a vertical plane. The hook *k* holds the rubber strips, as shown in Figs. 1 and 4, while the hook *l* engages a hook *m*. This hook *m* is easily made by passing a strip of steel wire through the meeting ends of the main strips *a*, the portions projecting from each side of the strips being bent into the hooks *m*.

The Skids.

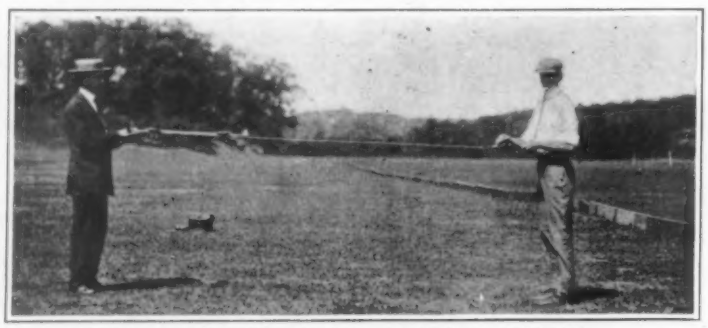
Three skids are provided, on which the model slides, one at the forward end, and two near the rear end. All are made of bamboo. As shown in Fig. 5, the front skid may be of any length that seems desirable. A 6-inch piece of bamboo will probably answer most requirements. This piece *n* is bent in opposite directions at the ends to form arms *o* and *p*. The arm *o* is secured to the forward ends of the two strips *a* constituting the main frame, by means of thread and glue. The strips and skid are not held together by the same thread, but the skid is attached to the two strips after they have been wound. Hence there are two sets of windings of thread, one for the two strips *a* themselves, and another for the skid and the strips. Strong thread and glue should be used, as before. In order to stiffen the skid, two bamboo struts *q* will be found necessary. These are bent over at the ends to form arms r^1 and r^2 (Fig. 5). Each of the arms *r* is secured to the under side of a strip *a* by strong thread and glue. The arms r^2 are superimposed and tied to the bamboo skid *n* with strong thread and glue.

The two rear skids, of which one is shown in Fig. 6, consist each of two 5-inch strips of bamboo *s*, likewise bent at either end in opposite directions to form arms s^1 and s^2. The arms s^1 are fastened to the strips *a* by strong thread and glue. To stiffen the skids a strut *t* is provided for each skid. Each strut *t* consists of a 3-inch strip of bamboo bent over so as to form arms t^1 and t^2. The arm t^1 fits the under side of the main strip *a*, the arm t^2 the skid *s*. Strong thread and glue are employed to fasten each strut in position on the strip *a* and the skid *s*. In the crotch of the triangular space *u*, formed by the skid *s* and the strut *t*, a tie bar *v* (Figs. 4 and 6) is secured by means of thread and glue. This tie bar *v* connects the two skids, as shown in Figs. 1 and 4, and serves to stiffen them. The triangular space *u* is covered with paper, preferably bamboo

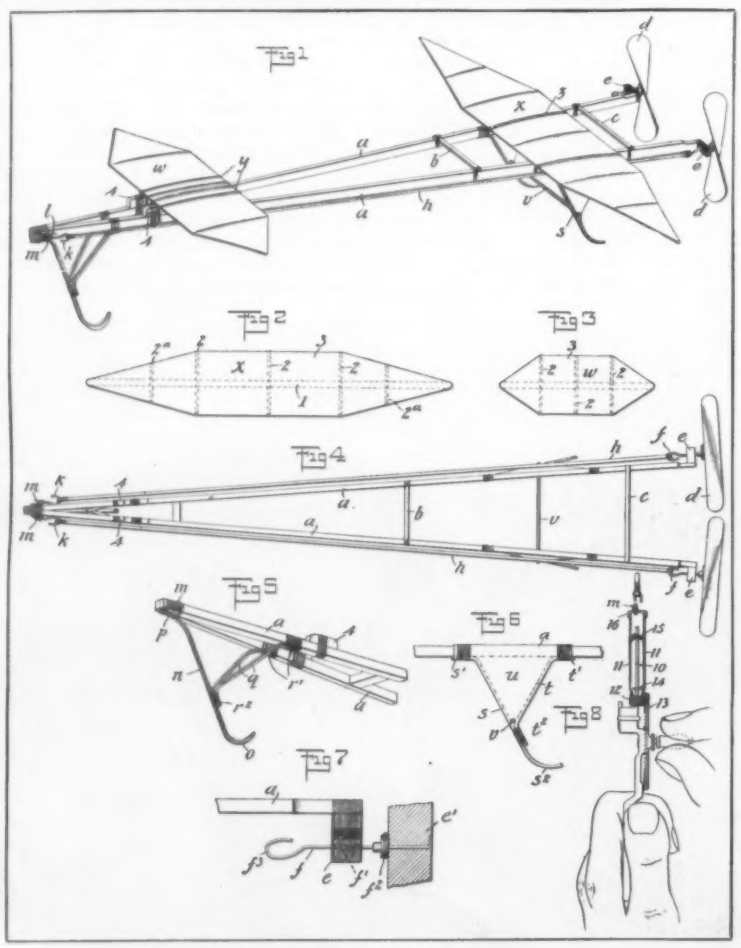
A group of boys at Van Cortlandt Park, all of whom have made their own model aeroplanes.



A hand-drill modified so as to wind up two rubber bands at once.



Winding up the rubber bands by which the model is driven.



Details of the model aeroplane.

HOW TO BUILD AND FLY A MODEL AEROPLANE

paper. If bamboo paper is not available, parchment or stiff light paper of some kind may be used. It does not need to be waterproof. Thus triangular fins are formed which act as stabilizing surfaces.

The Main Planes.

The main planes are two in number, but are different in size. Contrary to the practice followed in large man-carrying monoplanes, the front supporting surface is comparatively small in area and the rear supporting surface comparatively large. These supporting surfaces *w* and *x* are shown in detail in Figs. 2 and 3. It has been found that a surface of considerable area is required at the rear of the machine to support it. Hence the discrepancy in size. Although the two supporting surfaces differ in size, they are made in exactly the same manner. Each consists of a thin longitudinal piece of spruce 1, to which cross pieces of bamboo 2 are attached. In the smaller plane (Fig. 3) all the cross pieces 2 are of the same size. In the larger plane (Fig. 2) the outer strips 2*a* are somewhat shorter than the others. Their length is 2½ inches, whereas the length of the strips 2 is 3½ inches. In order to allow for the more gradual tapering of the plane, around the outer ends of the longitudinal strips 1 and the ribs 2, a strip of bamboo 3 is tied. The frame, composed of the longitudinal strip 1 and cross strips 2 and 2*a*, is then covered with bamboo paper, parchment paper, or any other stiff light paper, which is glued in place.

The forward or smaller plane has a spread of 8½ inches and a depth of 3¼ inches. The main plane has a spread of 20 inches and a depth of 3½ inches at the widest portion. The author has made experiments which lead him to believe that the tapering form given to the outer edge of the plane improves both the stability and endurance of the machine.

The planes are slightly arched, although it will be found that flat planes will also give good results. The rear edge of the main plane should be placed 4¼ inches distant from the forward edge of the propeller block *e*.

The front plane must have a slight angle of incidence, just how much depends upon the weight of the machine, the manner in which it is made, and various other factors. This angle of incidence is obtained by resting the front portion of the plane on two small blocks 4 (Figs. 1 and 5) which are fastened to the top of the main strip *a* by strong thread and glue.

The height of the blocks 4 should be about ¼ of an inch, although this will necessarily vary with the machine. The blocks should be placed approximately four inches from the forward end of the machine. The front end of the forward plane should be elevated about one-fourth of an inch above the rear end, which rests directly on the main strips *a*.

Both the front and rear planes *w* and *x* are removably lashed to the frame by means of ordinary rubber bands, which may be obtained at any stationery store. These rubber bands are lettered *y* and *z* in Fig. 1.

Winding the Rubber Strips.

The rubber strips can be most conveniently wound up by means of an egg beater, slightly changed for the purpose. The beater and the frame in which it is carried are entirely removed, leaving only the main rod 10, which is cut off at the lower end so that the total length is not more than two or three inches. The two brass strips 11 on either side of the rod, which are attached to the pinion 12, meshing with the large driving wheel 13, are likewise retained. A washer 14 is soldered to the rod near its upper end, so as to limit the motion of the small pinion 12 and the brass strips 11 attached to the pinion. Next a wire 15 is bent in the form of a loop, through which loop the central rod passes. The ends of the wire are soldered to the side strips 11. Lastly, a piece of wire 16 is bent and soldered to the lower ends of the side strips. In order to wind up a rubber strip, the strip is detached from the forward end of the model, and the hook *m* slipped over the wire 16. The opposite end of the rubber band is held in any convenient manner. Naturally the two strips must be wound in opposite directions, so that the two propellers will turn in opposite directions. By stretching the rubber while it is being wound, more revolutions can be obtained. It is not safe to have the propeller revolve more than 700 times. The ratio of the gears of the egg-beater winder can be figured out so that the requisite number of twists can be given to the rubber bands for that particular number of revolutions.

Instead of an egg beater, a hand drill can be used, as shown in one of our photographs. This, however, will have to be also modified for the purpose, a wire hook being inserted in the jaws. In the modified drill here presented, an extra gear has been provided so that the two rubber bands may be wound up at the same time in opposite directions.

Rules Governing the Competition for the $15,000 Flying Machine Prize Offered by Mr. Edwin Gould

1. A prize of $15,000 has been offered by Mr. Edwin Gould for the most perfect and practicable heavier-than-air flying machine, designed and demonstrated in this country, and equipped with two or more complete power plants (separate motors and propeliers), so connected that any power plant may be operated independently, or that they may be used together.

CONDITIONS OF ENTRY.

2. Competitors for the prize must file with the Contest Committee complete drawings and specifications of their machines, in which the arrangement of the engines and propellers is clearly shown, with the mechanism for throwing into or out of gear one or all of the engines and propellers. Such entry should be addressed to the Contest Committee of the GOULD-SCIENTIFIC AMERICAN Prize, 361 Broadway, New York city. Each contestant, in formally entering his machine, must specify its type (monoplane, biplane, helicopter, etc.), give its principal dimensions, the number and sizes of its motors and propellers, its horse-power, fuel-carrying capacity, and the nature of its steering and controlling devices.

3. Entries must be received at the office of the SCIENTIFIC AMERICAN on or before June 1st, 1912. Contests will take place July 4th, 1912, and following days. At least two machines must be entered in the contest or the prize will not be awarded.

CONTEST COMMITTEE.

4. The committee will consist of a representative of the SCIENTIFIC AMERICAN, a representative of the Aero Club of America, and the representative of some technical institute. This committee shall pass upon the practicability and efficiency of all the machines entered in competition, and they shall also act as judges in determining which machine has made the best flights and complied with the tests upon which the winning of the prize is conditional. The decision of this committee shall be final.

CONDITIONS OF THE TEST.

5. Before making a flight each contestant or his agent must prove to the satisfaction of the Contest Committee that he is able to drive each engine and propeller independently of the other or others, and that he is able to couple up all engines and propellers and drive them in unison. No machine will be allowed to compete unless it can fulfill these requirements to the satisfaction of the Contest Committee. The prize shall not be awarded unless the competitor can demonstrate that he is able to drive his machine in a continuous flight, over a designated course; and for a period of at least one hour he must run with one of his power plants disconnected; also he must drive his engines during said flight alternately and together. Recording tachometers attached to the motors can probably be used to prove such performance.

In the judging of the performances of the various machines, the questions of stability, ease of control and safety will also be taken into consideration by the judges. The machine best fulfilling these conditions shall be awarded the prize.

6. All heavier-than-air machines of any type whatever—aeroplanes, helicopters, ornithopters, etc.—shall be entitled to compete for the prize, but all machines carrying a balloon or gas-containing envelope for purposes of support are excluded from the competition.

7. The flights will be made under reasonable conditions of weather. The judges will, at their discretion, order the flights to begin at any time they may see fit, provided they consider the weather conditions sufficiently favorable.

8. No entry fee will be charged, but the contestant must pay for the transportation of his machine to and from the field of trial.

9. The place of holding the trial shall be determined by the Contest Committee, and the location of such place of trial shall be announced on or about June 1st, 1912.

10. Mr. Edwin Gould, Munn & Co., Inc., publishers of the SCIENTIFIC AMERICAN, and the judges who will be selected to pass upon machines, are not to be held responsible for any accident which may occur in storing or demonstrating the machines on the testing ground.

A Weather Forecasting Competition

THE Société Française de Navigation Aérienne has decided to organize a competition in weather forecasting, which will extend over a period of two weeks about the time of the vernal equinox of next year. This season was selected because it is supposed to be characterized by generally unsettled weather, and therefore likly to afford a severe test to the competitors. An elimination contest, the particulars of which have not yet been announced, will precede the principal competition, its object being to shut out the cranks and charlatans who might be disposed to participate in such an event.

The idea of a public contest in weather forecasting is not new. In the autumn of 1905 a competition of this sort was held by the Société Belge d'Astronomie for a prize of 5,000 francs. The competitors were first required to make daily forecasts based on the current weather maps published at the various meteorological centers of Europe; these were submitted by telegraph and registered mail to the jury assembled in Belgium, the members of which were all well-known meteorologists, viz., Messrs. Teisserenc de Bort, Rotch, Polis, Brunhes, and Vincent. From the twenty-four contestants the seven who submitted the most accurate forecasts were summoned to Liège to take part in a further test. Each of them was required to make a series of forecasts for a twenty-four hour period based upon seven weather maps selected at random from those published by the French meteorological service between the years 1880 and 1902. The jury, having at hand the maps for the days succeeding those selected, was able immediately to verify the accuracy of the predictions.

This second test resulted in the further elimination of four competitors, and the remaining three were then required to furnish a statement of their methods of forecasting. The jury unanimously awarded the prize to M. Gabriel Guilbert, of Caen, France, both for his successful forecasts and for his method, which was then first made known to the scientific world, and attracted wide attention.

M. Guilbert has since published a book on weather forecasting.[1]

The Mine-safety Demonstration

A NATIONAL mine-safety demonstration will be held at Pittsburg, Pa., on October 30th and 31st, 1911, under the auspices of the Bureau of Mines. The first day will be devoted to demonstrations at the Bureau of Mines Building in the Arsenal grounds, Fortieth and Butler streets, including exhibits of explosives, safety lamps, fuel testing, etc., and actual explosions. On the same day demonstrations and explosions will be given in the experimental mine near Bruceton, ten miles south of Pittsburg. On the second day the demonstrations will be held at Forbes Field, the National League baseball grounds. This programme will include a first aid exhibit, rescue work and mine gas. President Taft will be present and award the prizes, and will afterward be entertained at luncheon at the Hotel Schenley. It is expected that the Bureau of Mines will run a special car from Washington to accommodate the officials of the Federal government. There is at present prevailing a deep interest in the subject of mine safety appliances and many heads of bureaus and departments will grasp this opportunity of having ocular demonstration of the excellent work being accomplished by the Bureau of Mines. Dr. Holmes, the Chief of the Bureau, will, of course, be in charge of the demonstrations.

[1] Nouvelle méthode de prévision du tempe. Paris, 1909.

A Stabilizer for Aeroplanes

A FLYING machine having stabilizing means arranged longitudinally and both in front and rear of the vertical turning center of the machine is shown in a patent, No. 1,001,120, to Joseph A. Blondin of Los Angeles, Cal. The stabilizing means include a plurality of members which may be moved laterally to varying degrees which are connected to a movable aviator's seat, thus permitting the convenient operation of the stabilizing members.

(Continued from page 331.)

strength plus the reduction of resistance to sliding of the dam upon its undermined base, brought the strength of the dam below the yielding point, and the water burst through. Some broken sections of the wall appear to have been turned completely about their toe, others have been pushed bodily downstream upon their base, remaining erect.

There have been altogether too many failures of dams in this country during the past two decades. There is need for State legislative control. Individuals and private corporations should not be left at liberty to build where and how they will. The menace of a badly-designed and ill-built dam is so great, that the plans for all structures of this character should be referred to an expert board, appointed by the State, and strongly backed up in all its decisions.

Hail Insurance

THE insurance of growing crops against hail, though little practised in the United States, is an old and well-established institution in many parts of Europe. The first hail insurance company was organized in Scotland in the eighteenth century. A large mutual hail insurance company was founded at Brunswick, Germany, in 1791, and another at Neubrandenburg, Germany, in 1797. To-day there are scores of companies in Europe. The greater number of these are conducted on the mutual plan, though there are also many stock companies. In several countries hail insurance companies enjoy a government subsidy; while in one, Bavaria, the government itself insures agriculturists against hail. A similar plan is in operation in the Canadian territory of Alberta, where hail insurance is conducted by the Treasury Department.

From time immemorial mankind has endeavored to find some physical means of preventing hailstorms. In antiquity the custom of hurling javelins and other missiles against clouds that threatened a discharge of hail was widespread. In the middle ages the aid of the "tempestarii" sorcerer who claimed the power of influencing the weather—was invoked to the same end. Bells, also, were believed to be efficacious in averting hailstorms. Early in the nineteenth century metal-tipped poles, called *paragrandines* or *paragreles*, imitated from lightning-rods, were set up in great numbers in many parts of Europe, in the belief that they would draw off the free electricity of the air, which was assumed to be the chief cause of hailstorms. About 1896 the custom of "hail-shooting" was introduced in Europe, especially in vine-growing districts, and soon became immensely popular. This consisted in bombarding the clouds with various special forms of cannon. In the year 1900 five hundred of these cannon were in use in France and Spain, 2,000 in Austria-Hungary, and 10,000 in Italy. This custom still flourishes. In Austria and Italy it has been investigated and reported upon unfavorably by scientific commissions, appointed by the respective governments. On the other hand, in France and in parts of Russia it has the approval of official or quasi-official authorities. It is, however, open to the fatal objection that, even should it prove efficacious, the expense entailed in systematic protection by this method is in excess of the benefits to be obtained. This has been well demonstrated by Baermann for Bavaria and Württemberg, and Hahn for the whole of Germany. Thus, assuming the necessity of installing one cannon per square kilometer, the cost of a complete installation for Bavaria would amount to $7,500,000; and the annual cost of operating would be about $1,750,000.

In the absence of any practical method of actually averting the destructive effects of hail, the agricultural population must look to insurance to mitigate the loss to the individual sufferer. At the present time, however, hail insurance, although as stated above has been practised for over a century, is founded upon a far from secure basis of information. Statistics of the distribution of hailstorms in space and time, and of the damage inflicted thereby, are systematically collected from year to year in but few countries. For the most part, the companies have been obliged to gather their own information as best they could; and doubtless, in the legitimate desire to protect themselves having regard to the uncertainty of the data available, they have as a rule imposed higher premiums than would be justified if accurate information were at hand. That the aggregate loss due to atmospheric visitations of this class is exceedingly heavy is well known. Thus it is stated that during the year 1897, in the kingdom of Württemberg, a total area of 42,427 hectares—3.7 per cent of the cultivable land of the country—was ravaged by hail, the damage amounting to over $4,750,000. In the last forty years the loss to agriculturists from this cause in the grand duchy of Baden has aggregated $25,000,000. The annual loss for the whole of Germany is estimated at between 70,000,000 and 80,000,000 marks (i. e., from $17,000,000 to $20,000,000). The annual loss in France is about the same. In Italy it amounts to $12,000,000, according to a recent estimate. These enormous losses do not affect the agricultural class alone. In many cases the national revenues are seriously curtailed from this cause, as it is found necessary to remit a portion of the taxes in the regions afflicted.

The first steps toward improving the organization of hail insurance and extending its benefits to all countries have been taken during the past year by the International Institute of Agriculture. At a meeting of the permanent committee of the Institute, November 24th, 1910, the Bureau of Economic and Social Institutions was charged with the task of drawing up a complete report on the present situation of this form of insurance in the several countries. The report, prepared by Dr. Giuseppe Rocca, has now been published,* and is a most useful contribution to a subject the literature of which is at present extremely meager. Dr. Rocca gives statistics of the companies engaged in the business of hail insurance in Germany, Austria, France, Hungary, Italy, and Switzerland; the laws bearing on the subject in those countries; the technique of this class of insurance; and finally a number of suggestions looking to a uniform system of gathering information of damage by hail and to uniform legislation.

This report was submitted to the Institute at its recent general meeting, and recommendations based thereon will be transmitted to the several governments.

As the recommendations of the Institute will probably lead to the organization of hail insurance companies in this country it may interest some of our readers to know that a number of books has been published in Germany for the guidance of persons engaged in the task of assessing the damage due to hail. A list of them will be found at the end of the article "Hagelversicherung," in Meyers Grosses Konversations-Lexikon, sixth edition.

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Houses were swept before the flood like cardboard.

Copyright by Underwood & Underwood 1911.

Looking downstream through gap in the wall of dam.

View along upper face, showing displacement of broken masses.

THE FAILURE OF THE AUSTIN DAM

The Colors of the Earth

THE two great elements of difference in the same landscape in winter and summer are, of course, the presence of snow in winter and of leaves and grass in summer. If we could look at our globe from the moon the variation in its aspect due to seasonal changes would perhaps be even more striking than it appears to those on the surface.

In fact, we sometimes lose sight of the very important part which vegetation plays in giving color to what might be termed the countenance of the planet.

It is not the higher forms of plants that always produce the greatest effect in this way. Some of the most striking scenes upon the earth owe their characteristic features to mosses and lichens. The famous "crimson cliffs" of Greenland, which extend for miles northward from Cape York, derive their splendid color from the growth of red lichen that covers their faces.

The cliffs rise between seventeen hundred and two thousand feet straight from the water's edge, and being composed of gray granite, their aspect would be entirely different from what it is but for the presence of the lichen.

The rocky pass called the Golden Gate in the Yellowstone National Park owes its rich color and its name to the yellow lichen covering its lofty walls; and the indescribable hues of the great hot-spring terraces arise mainly from the presence of minute plants flourishing in the water that overflows them. Considered as a whole, the vegetation of a planet may give it a characteristic aspect as viewed from space. That its broad expanse of forest and prairie land causes the earth to reflect a considerable quantity of green light to its neighbors is indicated by the fact that at the time of the new moon a greenish tint has been detected overspreading that part of the lunar surface which is then illuminated only by light from the earth.

* "L'assurance grêle dans quelques pays, et ses problèmes. Materiaux pour aider à une entente internationale." Rome: Imprimerie de l'Institut International d'Agriculture. 1911. 1p. x, 155, 4to.

Glenn H. Curtiss, winner of the Scientific American trophy, first to rise from water in a biplane.

Louis Blériot, France's premier monoplane inventor, first to cross the English Channel, July 25th, 1909.

Wilbur Wright, the elder of the two brothers who built the first practical aeroplane.

Morane, the former Blériot pilot, who has invented an exceedingly fast and efficient monoplane.

The Business Side of Aviation

The Money in Flights and Machines

IT SEEMS at first glance somewhat premature to rank the new art of flying among the accepted and recognized branches of industry; but on close examination of the actual state of aviation affairs at present there is found ample reason for doing so.

In the past three years an astonishingly large field of commercial and business activity has been built up, that has to do solely with aeronautics.

There are few who have stopped to realize the suggestive fact that more than half a million men are now actively engaged in some industrial enterprise that has to do with navigation of the air.

To fully appreciate the significance of the commercial side of aviation, a knowledge, or at least an acquaintance, must be had with demands on a flying machine, its uses and the commodities whose manufacture, sale or exchange constitute "the trade."

Aeroplanes at present are used in three distinct ways—for sport or convenience, in war or postal service, and as a means of profit in exhibitions, etc.

The use of the aeroplane by sportsmen and its use by individuals or corporations as a convenience, is the field best developed at present, and for which the greatest future is predicted.

The use of aeroplanes in war seems already definitely assured.

Exhibition flying, however, is likely, and in fact has begun to decline, although races if sufficiently exciting are likely to persist.

A great impetus to the use of aeroplanes by sportsmen is bound to come soon, with the further perfecting of the hydro-aeroplane.

The Trade.

The market for aeroplanes is of considerable magnitude, as indicated by the volume of sales made by the various companies. M. Blériot has sold several hundred aeroplanes since the spring of 1909, when he first began manufacturing them on a large scale. He has almost been outdone by the Voisins and Henri Farman, while the enterprise of Esnault-Pelterie, Sommer, Breguet, Nieuport, and a score of other constructors in France brings the total of actual sales to a surprisingly large figure.

A single-seater Blériot monoplane costs 24,000 francs, and a two-seater, 28,000 francs. This is also the price of Voisin biplanes. A Breguet biplane costs about $6,000 and an Antoinette monoplane is even more expensive.

In general, the range of prices in France is from 15,000 to 30,000 francs.

In England the cost of "all-British" machines like the Valkyrie and Howard Wright runs from $1,500 upward, the price of English made machines being much lower than for those of foreign make.

In the United States there are not over a dozen large and established manufacturing firms, with the Wright, Curtiss and Burgess companies as recognized leaders. The Burgess Co. has sold more than thirty machines, the Wright Co. two or three times as many, and the Curtiss firm also a considerable number. The average price of American machines is $5,000, although the Burgess Co. charges $7,500 for a biplane of the Wright type equipped with a Gnome motor. The sales here are at present much less than abroad.

It may be conservatively estimated that the sales of aeroplanes to date, both here and abroad, amounts to about 1,500. Placing the average price paid for these machines at $5,000, it becomes evident that the volume of business is represented by an outlay of well over $7,000,000.

In England, for example, the import trade from January to August, 1911, is represented by $177,000, and the export trade by $70,000, thus giving an insight into the magnitude of the trade between England and foreign countries. The exports of France and the imports of America are greater, all statistics proving that France leads the world in the aeroplane industry.

The Blériot factory employs about 600 men, and is replete with the most up-to-date facilities. The Wright Company has an equally efficient plant of modern buildings, shops and assembly rooms. In fact the growth of most aeroplane factories has been phenomenal, and yet the real lasting market for the aeroplane has been but slightly reached.

Greater even than the trade in aeroplaning, as a unit, has been the activity in the supply and demand for aeroplane accessories from motors and propellers to the minutest parts of metal or wood.

There are fifty or more established firms in this country alone, doing a large business in parts of aeroplanes, like ribs, struts, joints, etc. As in France, propellers are being designed and manufactured by more than ten firms devoted to this alone.

In France the Chauviere Company is a large corporation employing many hundred men, with extensive shops, and turning out countless propellers for all types of aircraft.

Many of these separately manufactured parts never get to be used in a full fledged aeroplane, but serve merely for purposes of experiment.

The motor trade is also large, especially in France. The Gnome company pays dividends that few "industrials" ever reach, and its business grows apace. Many American motors are showing excellent qualities and are much preferred here to the higher priced foreign motors.

Aeroplane supply houses abroad have ceased to be

(Continued on page 355.)

Lagagneux, the all-around French aviator, who has made records with both monoplanes and biplanes.

Claude Grahame-White, England's leading aviator. He has won many cash prizes.

Weyman, the American, who won the Gordon Bennett Cup race this year in England.

Louis Breguet, first to carry live load equaling weight of machine.

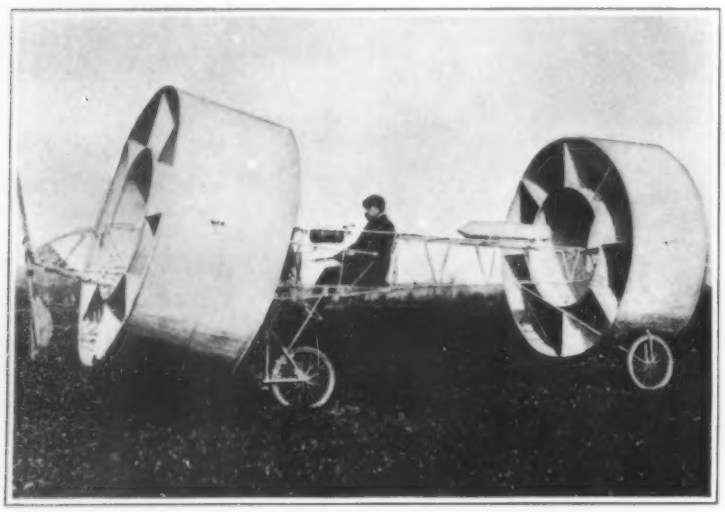


Fig. 1.—This designer was haunted by the fear of edgewise tumbling. He did not know that drums are inefficient lifting surfaces.

Fig. 2.—A marquis's idea of applying the principle of centripetal stresses. Too much head resistance here.

Fig. 3.—If two planes are better than one, three must be better than two, argued this designer, taking no account of the head resistance.

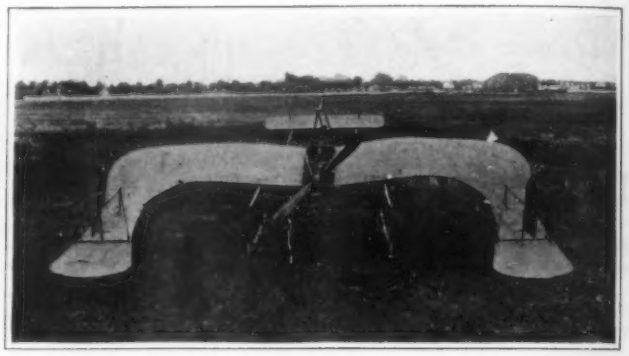


Fig. 4.—Here the eye rests in peace, for compared with standard designs the variations are more conspicuous than radical.

MIDSUMMER MADNESS IN AEROPLANE DESIGNS

A Chamber of Horrors

Wild Designs in Flying Machines

By Marius C. Krarup

EVERY one of the aviation machines shown in the accompanying illustrations is dear to its maker or designer and to his friends. Every one of them has something in its construction which is promising, sensible or brilliant to men whose ability in the ordinary walks of life has been sufficient to enable them to save or borrow the money wherewith to substantiate their faith in aviation. All but one are proudly photographed ready to fly at the word "go." Yet only the one not so pictured ever made a start. The others probably still cherish the convictions which created them by means of occult or theoretical qualities, the nature of which the uninitiated beholder may only surmise. Here is a problem for the psychologist to solve. Mechanics alone scarcely furnish the key to its correct solution. The shrewd observation that it is better to get into the "game of aviation" wrong than not to get into it at all in its beginning may have shaped many of the hasty creations which abound in the shops of amateur aviators the world over. They are evidence of a widespread desire to become identified at almost any cost with a movement clearly destined to be more conspicuously picturesque in its unfolding than any other which civilization has ever witnessed, and prodigiously fruitful in physical, scientific and financial adventure. These odd structures are claims staked off on the hills of golden promise, and the cheerful prospectors confidently expect to "grow up with the country," and to reap the rewards which come to all sturdy pioneers. A single unproportioned thought, "given his act" contrary to the advice of Polonius and embodied in steel, wood and fabric, is boldly offered as the entry fee, and lo! the world generously accepts it. For is it not after all proof of courage and energy, those primary traits of character which are as much needed for progress as mere insight, which grows with what it feeds upon and may be acquired. These men shall have free passes to glory and advancement, provided they stand by their claims, work them and guide their next steps a little more closely to the sum total of dry facts and experiences from which real flying aeroplanes have been evolved.

The unproportioned thoughts manifested in the various machines are not without interest. The edgewise tumble has haunted the maker of No. 1. Of this he is sure: So long as the motor and propeller are kept working, these drums will uphold whatever they are capable of upholding, whether the wind tosses them to one side or the other. Pivoted as they are to the elegant trussed frame, they afford means for sustentation, for steering and for fore-and-aft balancing, all combined in a single mechanical conception. If the propellers cease propelling, simply tilt both drums forward for a gradual descent. Should the impact with the earth be a little hard, the structure offers the same advantage which has served Latham so well in his Antoinette flier; namely, that there is much material to be broken before the shock reaches the aviator's person. It seems almost a pity that the laws of the atmosphere will not permit drums to act as efficient aeroplane lifters.

The machine shown in Fig. 2 is the contribution of the Marquis d'Equeuvillay. It may be imagined that the scion of a noble house has started his train of thought with a profound respect for the magic strength of a bicycle wheel. By developing its great principle of centripetal stresses it should be possible to produce a very light framework rich in capacity for areas, strong and yet deformable at its ovalized periphery, and, Eureka! with motor and aviator centrally located and applying the vital forces of propulsion and control from the rigid hub, the very deformation of the rim and planes might be utilized for steering and balancing. Note also the forethought evinced in shaping the upper planes with a self-righting curvature.

If two planes are better than one, then three planes are better than two. This is the simple and powerful idea embodied in the apparatus pictured in Fig. 3, and which is known as the Bousson-Bourgnis. It is common to many triplanes. In addition, an abundance of rudders, generous in size, and a certain flabby flexibility in all the areas, testify to an active, energetic misunderstanding of nearly all the leading principles in successful aviation. The head-on resistance is enormous. What might perhaps have been gained by using perfectly elastic materials shaped and proportioned so as to return an equivalent in work for the power expended in bending the planes back, is squandered through the acceptance instead of unresponsive materials, endowed with an inert flexibility rather than resiliency, the bending of which, under the influence of air resistance, means mainly the generation of heat from molecular friction and the consequent wasting of the power employed for overcoming the air resistance.

Stoeckel's monoplane (Fig. 6 in this series) was expected to work a revolution in aeroplane dynamics, for it is equipped with a motor of only twelve horsepower driving two propellers of very modest diameters located far below the level of the planes and the bulk of the air resistance. Under these circumstances the machine should immediately tip over backward the moment the wheels leave the ground, but the designer has placed an inverted canoe, also useful as a sunshade, lengthwise over the central portion of his machine, and in this device he must have anticipated special virtues, not only the feeble merits of an undersized parachute, but something extraordinary in the way of balancing effect, since it is otherwise an axiom among aeroplane builders that the power and the air resistance must be kept pretty well in line. As a wind wagon skipping nimbly over the aviation field the compact Stoecker, with its short wheelbase, should have real merit, however, not to be despised for meets, particularly if the inverted canoe, as the illustration suggests, may be tipped and utilized to preserve the balance.

The largest aeroplane in the world is shown in Fig. 5. It was constructed at Dunstall, near Wolverhampton, by Lieut. Seddon of the British navy. It is equipped with two 80 horse-power engines and its planes measure an area of 1,000 square feet. The boldness of the figures and of the mechanical execution, with the great hoops and sweeping curves suggesting the expert in Spencerian handwriting, almost disarms criticism, numbing it with the query: Can this be possible? Can this be what we are striving for and

what we are coming to? In that case, would it not be better to leave aviation alone until a more advanced mastery of materials shall have made it possible to accomplish it by simpler designs? The large hoops, crossed with others like them and tied at the crossings, give great freedom in producing any desired relation between the planes. By mere changes in the angles and the points of contact of the hoops, practically the same framework may be utilized for a number of experimental variations, and perhaps it may be assumed that the designer has been actuated by this consideration, knowing that the tandem arrangement of planes has been found unfavorable to equilibrium, but knowing also that no large aeroplane construction can be expected until this difficulty shall have been experimentally overcome. But the design looks more theoretical than inspired.

The engineer responsible for the example in Fig. 7 has also tackled elongated construction, being plainly actuated by hopes of escaping from the problem of lateral equilibrium. As for the necessary sustentation, fancy this scow being sucked forward through the atmosphere at great speed by the innocent little propeller, and the friendly mind will readily perceive how the bow will throw powerful air waves upward against the flying-fox membrane extending from the gunwale, fairly lifting the structure; and, moreover, the hollow of the scow will create a vacuum—the vacuum being a highly favored phenomenon among independent aeroplane designers, nearly always produced without special expenditure of power—to fill which a mighty upward pressure from the atmosphere underneath will automatically assert itself. The hand wheel in front of the operator seems to connect with a simple rudder at the top for side steering, and the perfect lateral balance produced by the narrow conformation and the low center of gravity (really permissible with this shape) should render all other and auxiliary steering means superfluous. For up-and-down steering perhaps the aviator slides his own weight forward and backward.

The seven machines mentioned and illustrated in the foregoing might have been proposed and built whether Lilienthal, Maxim, Langley, the Wrights and Blériot had ever gathered data for aviation or not. But on the Diapason monoplane (Fig. 4) the eye may rest in peace. As compared with standard design, its variations are more conspicuous than radical. The tail and side-steering apparatus have been cut in twain and moved to the two sides; the *ailerons* have been moved rearward. The arrangement makes room for a large propeller, and, while the equilibrium seems more sensitive, the means for maintaining it and for steering may at the same time have been improved. The machine is said to have flown with some success, and it would be rash to assert its superiority or inferiority in comparison with other models depending on control by rudder action. It accentuates this feature, making even stronger demands upon the aviator's agility than the standard type.

Recent Aeroplane Accidents

DURING the past month there have been many accidents. In several of these the aeroplane has caught fire in the air, and the aviator has been burned to death or killed by the fall. One such accident occurred in France on September 2nd, another in Spain two days later, and the third, in which two men were killed, happened in Germany on the 7th ult. Maron, the French pilot of the Savary biplane, was the first victim of this type of accident. He experienced a bad fall on the 2nd ult. His machine caught fire, and when it struck the ground, he was incinerated under the débris. Lieut. de Grailly, of the French army, also fell and was burned to death on the 2nd inst., owing, it is claimed, to the breaking of a wing of his R. E. P. monoplane. Capt. Camine, with the same make of machine, was killed by the fall due to the same cause. On September 5th, M. Leforestier, a French aviator, fell to his death at Huelva, Spain. His machine, which was of his own construction, is said to have caught fire in the air.

Two other men who were victims of this kind of accident were Lieut. Newmann, a German military aviator, and M. Leconte, his passenger. While making a cross-country flight on September 7th the machine caught fire when at a height of sixty feet, and fell to the ground, instantly killing both aviators. The same day, Paul Senge, another German aviator, fell and fractured his skull at the town of Karlsruhe.

Two days later Herr Eyring was killed near Stuttgart. On September 29th, Capt. Englehardt, Germany's premier military pilot and the first man whom the Wrights taught to fly in that country, was killed by a fall, while his passenger, Herr Sedlmayer, had his skull fractured and received other serious injuries.

In England, Lieut. Cammell, a seasoned Blériot pilot, on the 18th ult., fell to his death while making his first flight in a Valkyrie (English) monoplane. He had been aloft 10 minutes and was making his second wide circuit, when the monoplane turned over and dropped 90 feet to the ground. Capt. J. J. Frisbie, Louis Rosenbaum and Cromwell Dixon were killed in America when flying at State fairs. The last-named aviator, a youth of but 19, fell 80 feet into a stone quarry at Spokane, Wash., on October 2nd, owing to his turning too sharply to avoid hitting some telegraph wires, and sliding down on end as a consequence. A few days before, at Helena, Mont., Dixon had flown over the Rocky Mountains to Blossburg, a small town 18 miles away, and back again. Blossburg lies in a deep pocket in the mountains, from which wild ducks and geese escape with difficulty after battling with the air currents sometimes for hours. It took Dixon twice as long—22 minutes—to attain the necessary altitude of 7,000 feet at Blossburg as it did at Helena. The trip out and back across the 6,200-foot Mullins Pass was made in 15 and 17 minutes respectively. Dixon was given a $10,000 purse made up by several men who witnessed his flight. He delivered a letter from Governor Norris. This is the second time a Curtiss biplane has crossed the Rockies. Ely was the first to accomplish this feat at Butte, Mont., last spring.

On September 25th, at the Nassau Boulevard meet, Dr. Clark, a trick bicyclist, had a fatal fall in a Queen monoplane. He was unable to accustom himself to moving the warping control lever outward instead of inward when turning. A sharp turn to the right, caused by improper warping, resulted in the instant development of gyroscopic force by the revolving motor sufficient to make the machine dive vertically to the ground.

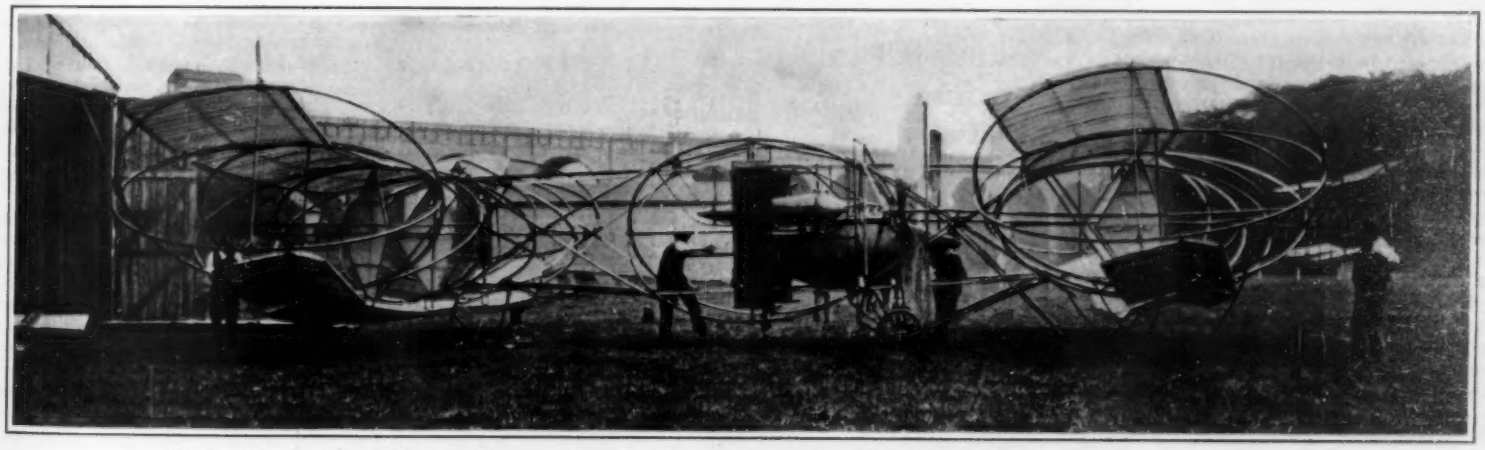


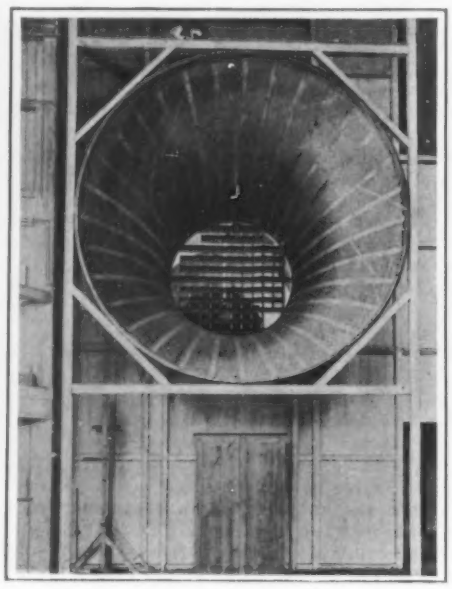
Fig. 5. – Here is a huge machine which seems to have been designed by one who admired the sweeping curves of copybook penmanship.

Fig. 6. – A monoplane that was expected to "revolutionize" aerodynamics and didn't.

Fig. 7.—Fancy this scow being sucked forward through the atmosphere at great speed by the innocent little propeller!

WHAT IGNORANCE OF AERODYNAMIC PRINCIPLES LEADS TO

Prof. L. Prandtl of Goettingen.



A view of Eiffel's wind tunnel.

After a painting by Morot.

Gustave Eiffel.

Progress in Aerodynamics

Studying the Aeroplane in the Laboratory

By Grover Cleveland Loening, Author of "Monoplanes and Biplanes"

IT is the precise methods of engineering that will eventually place flying on a successfully commercial basis. As in all other branches of engineering, the theorists and the physicists point the way and give the methods that lead the practical man to the definite solution of perplexing problems, and in this aviation differs in no respect from any other art or science.

The determination of the fundamental characteristics of air flow and air pressure on different kinds of surfaces and forms has led without doubt to a quicker and surer success in actual aeroplane flight, but it is qualitative rather than quantitative results that have been obtained so far.

Up to the present few if any experiments in measuring the actual values of pressures on surfaces have been conducted on full-sized aeroplanes. The results that have been obtained come chiefly from extensive indoor laboratory experiments conducted on planes and shapes of small size, often only one-thousandth of the size of planes used on successful machines.

But these small-scale experiments have in most cases been performed with great care and refinement, and from their results there are established the following empirical and fundamentally important laws and equations:

A. Any air pressure on any plane or shape varies within the range of speed used in flight, substantially as the square of the velocity, and directly as the size of the surface. For the simplest case, a flat plane placed normal to the air stream, the air pressure P may be expressed as

$$P = K\,S\,V^2$$

where S = the surface area, V = the velocity of the moving air against the fixed surface or conversely of the moving surface against the still air, and K = a numerical constant, the most probable value of which is 0.003, when S is expressed in square feet and V in miles per hour.

This is an empirical relation, derived from the results of many experiments, and upon it is based practically all of the theory of aerodynamics that finds application in actual practice.

B. Air passing a surface, or conversely a surface moving through air, causes a frictional drag on the surface, which varies almost as the square of the velocity and directly as the length of the surface.

Many formulæ have been proposed, some based on experimental data and some on theoretical conclusions, but they differ widely from one another, and the value of this "skin friction" is still a subject of controversy, many experts claiming that friction is negligible, many others that it is of considerable value. Here is a branch of aerodynamics still open to investigation, although the excellent results of Prof. Zahm seem almost conclusive evidence of the large value of frictional resistance.

C. The pressure on an inclined flat plane varies with the angle of inclination to the air stream, but bears a fixed relation to the pressure on the same plane, when placed normal to the air stream. If we let P = normal pressure, and P^1 = pressure acting on a plane when it is inclined below normal, at an angle a above the horizontal, then we may express this fixed relation between P and P^1 as

$$P^1 = P\,\frac{2\sin a}{1+\sin^2 a}$$

This is known as Duchemin's formula, and has been verified again and again by actual laboratory experiments on small flat planes. A very simple approximate relation suggested by Eiffel is

$$P^1 = P - \frac{a}{30}$$

The normal pressure P may be determined for any plane at any velocity by the relation of $P = KSV^2$, this pressure being gradually reduced as the plane is inclined to a value P^1, corresponding to that angle of inclination.

D. The pressure on arched planes is much greater than on flat planes, and may be equated to the value of the pressure on a flat plane of larger area. Whereas in inclined flat planes the pressure P^1 is always perpendicular to the plane, on inclined curved planes at low angles P^1 is inclined in front of the perpendicular to the chord of the plane.

Unlike flat planes, the pressures on curved planes cannot be reduced to intelligible formulæ, and therefore in order to determine the pressures on curved inclined planes, resort must be had to tables of air pressures obtained from actual measurements on test surfaces and not to any formulæ based on such measurements. The pressure P^1 on curved planes is usually tabulated as some percentage of the normal pressure P. It is in the determination of the pressures on curved surfaces that the results of aerodynamical experiments on small surfaces have been of most use in aeroplane designing. Lilienthal, Wright, Prandtl, Eiffel, Maxim and Stanton have all made determinations for curved planes that have found much practical application.

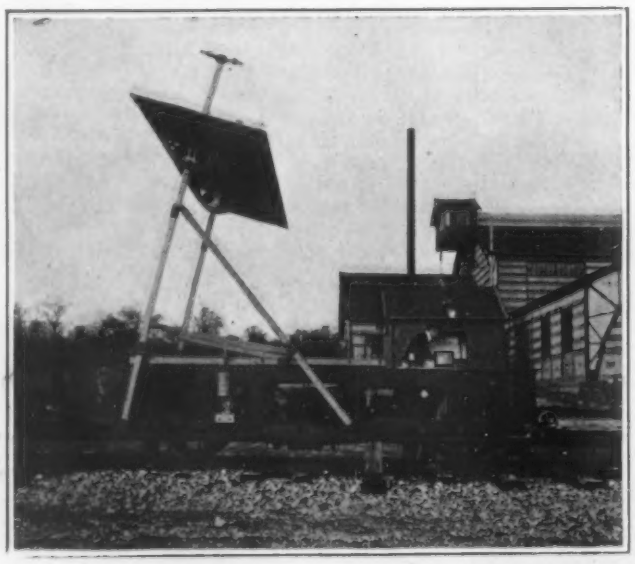
E. On curved planes, as well as on flat planes, the total pressure P^1 acting on the plane when the latter is inclined at an angle a, may be resolved into a vertical component L and a horizontal component D. The component L is called the "lift," and is equal to the weight of the aeroplane, while D is called the "drift," and is the dynamic resistance to motion overcome by the thrust of the propeller.

F. On curved planes, as the depth or amount of curvature or arching is increased, the drift resistance increases. In other words, flatter planes have less resistance than more highly arched ones. The experimental results of Prof. Prandtl of Göttingen are particularly definite on this point.

G. On curved planes, as the aspect ratio or ratio of span of plane to chord is increased, the lift increases greatly for the same area. Both Eiffel and Prandtl have amply verified this.

H. Experiments show that on a plane there exists a point at which all the pressures on the plane may be considered as concentrated without disturbing the equilibrium. This center of action of the forces is called the "center of pressure." On flat planes the center of pressure moves steadily forward from the center of the plane to a point near the front edge as the plane is inclined from the normal or 90-degree position to 0 degree. On curved planes a totally different action is observed. The center of pressure moves steadily forward from the center of figure to a point about one-third the width of plane from the front edge, as the inclination is reduced from 90 degrees to 15 degrees, but at this point it turns abruptly and moves rapidly to the rear, passing the center of figure at about 5 degrees.

J. Experiments in aerodynamic laboratories have further enabled forms of least resistance to motion to be determined and show what kind of torpedo or fusiform



Apparatus recently used in France for testing large surfaces in the open air.

shapes give the least disturbance of the air streams.

K. In addition, experiments on propellers have added immensely to the knowledge on this branch of aerodynamics, and have enabled air propellers to be designed that give a higher efficiency than is obtained in marine practice. The great French propeller manufacturing companies have had elaborate experiments conducted on full-size propellers, and have used the results to great advantage.

L. The experimental photographing of the action of air streams on different planes and shapes has been a valuable contribution to aerodynamics and holds promise of becoming a field of much larger scope within a few years.

These are fundamental "qualitative" results.

In many cases the values of different experimenters for the same thing show wide variations. In determinations of the constant *K*, for example, various values from 0.0025 to 0.0046 are obtained, and many other differences are found. The "quantitative" results of experiments in aerodynamics are as yet not fixed, and it must be conceded that until reliable numerical values are obtained the precise engineering design that is looked forward to is hardly possible, even though excellent approximations may be made.

The chief sources of error or difference in the experiments conducted thus far appear to be in the method and size of planes used. Whether size of surfaces has any effect on the nature of the pressures or their unit values is a problem in aerodynamics that is still to be solved. Many claim that the majority of experiments have been conducted on such small test surfaces that their results are of little value. Like all other aerodynamical problems, the answer is to be found in experiment only.

There are five different methods of conducting experiments on test surfaces or models. These are:

1. Dropping the surface from a height in open air or in a closed room. M. Eiffel conducted a series of experiments on the Eiffel Tower in 1905, in which he allowed the test surfaces to fall about 300 feet. Lilienthal made some use of this method in the open air, and at the Russian Aerodynamic Institute of Koutschino, built by M. Riabouchinsky of Moscow, it has been employed.

2. Attaching the surface to a carriage moved on rails, as done by Prof. Prandtl at Frankfort, or sliding down a long inclined railway, as performed by M. Canovetti in Italy.

3. Mounting the surface and testing apparatus on an automobile and driving at high speeds, taking careful record of the pressures. This method was employed to great advantage by M. Esnault-Pelterie some years ago in France.

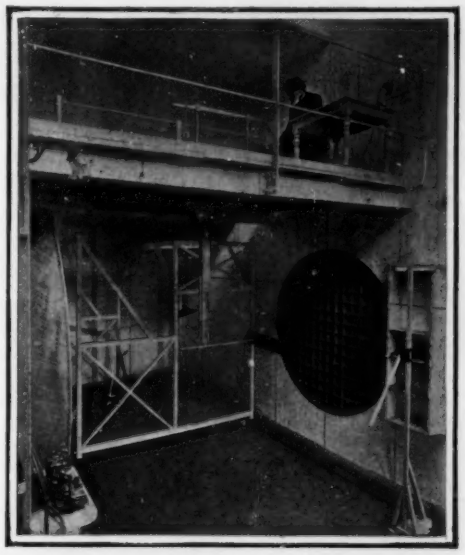
4. By means of a "whirling table" or large rotating arm, at the outer end of which are carried the forms and planes to be tested. The first aerodynamic testing apparatus, the old 8-foot whirling arm of Rouse used in 1758, was of this type. Later Langley, Maxim, Renard and Lilienthal used it to determine pressures on planes, and to test propellers. The huge new Vickers-Maxim testing table is the latest device of this kind.

5. By a wind tunnel. There are three main kinds of wind tunnels. In the first, used by Eiffel, Prandtl and Maxim, a huge fan blows air into a restricted passageway, and the air is then conducted through various screens and chambers until it issues out past the test surfaces in a more or less uniform steady current. At Göttingen the elaborate character of the air passageway and screens renders the air stream practically perfect in its evenness of flow as it passes the test planes. In the second type of wind tunnel the air is drawn in past the test surfaces by a powerful fan placed in back of them. This is designed to avoid the "churned" air that is exhausted from a fan or propeller. Dr. Stanton in England and Prof. Zahm in this country use wind tunnels of this type. The third type consists of a fan blowing air through a chamber and screens as before, but at the end of the chamber is a nozzle which contracts the air stream and greatly increases its velocity. M. Rateau has used a wind tunnel of this type in his laboratory in Paris.

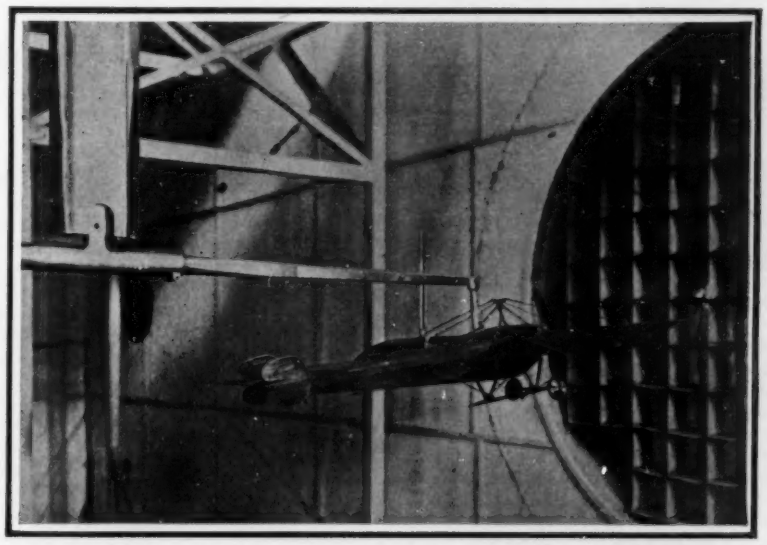
The actual devices for measuring the pressure vary greatly with the different experimenters, and this plays, no doubt, an important part in the variations observed in their results. Pressure gages, often inaccurate, hydraulic apparatus, aerodynamic balances of great sensitiveness, pendulum devices capable of very exact calibration, graphical records on cylinders by movable pointers, electrical contact devices and comparison systems with standard flat planes, are some of the many means employed.

To measure the actual velocity of the air stream, anemometers are used, and are either of the rotary cup type, recording on dials, or of the pressure type, in which the pressure of a surface acts through a spring and operates a large pointer.

Only recently the great differences between conditions of air pressure and air flow inside a room and out in the open air have been recognized. The air in a closed room is perfectly quiet and lacks the characteristics of turbulent motion of the open air, characteristics that very likely have much to do with pressures on a surface of an aeroplane. Although a simple means of determining air pressures, the wind tunnel resembles only slightly actual free flight conditions, and many of the results obtained by this method of experiment are seriously open to question.



Eiffel's laboratory. General view of the blower opening in front of which the test planes are mounted.



Scale model of the Nieuport monoplane, experimented with by Eiffel.

Whirling arms, if small, or if rotated at too high a velocity, cause the air about them to assume a rotation, and thus render the results of the experiments inexact.

Movement in a straight line in the open air is now recognized as the best means of experiment in aerodynamics, and the one that holds the greatest promise of establishing fully and exactly the great laws of flight.

The next step forward after experiments with small test surfaces has already been taken. M. Eiffel, for the past few months, in his splendidly equipped laboratory at the Champ de Mars, Paris, has been making determinations on reduced reproductions of actual aeroplane types, models equipped with propellers, motors, wheels and all. These experiments, despite their small scale, are the most valuable conducted so far, and have enabled M. Eiffel to lay down many more fundamental laws that have a direct and important bearing on aeroplane work.

One of the most interesting facts he has brought out is that when two identical planes are superimposed as on a biplane, the lift per unit of surface is less than if the same surface is used as a monoplane. These significant results show that as the distance between the planes is increased from 2/3 to 3/3 and to 4/3 of the depth, the corresponding reduction of unit pressure due to placing the two planes one over the other is 65 per cent, 70 per cent and 75 per cent.

M. Eiffel made extensive measurements on model wings of eighteen different aeroplane types, and made especially complete measurements on models of the new R. E. P. and the Nieuport monoplanes. His investigations on the distribution of pressure over a plane show definitely that the pressure at the front edge is very high, much higher than most aeroplane constructors suppose, and that at the rear it is very low, having often a negative value; i. e., the air is pressing on the upper face of the plane instead of the lower face.

Flight is being rapidly advanced and made safe by the instructive experiments of searchers in this new and fascinating science of aerodynamics.

The Moon and the Clouds

IN *Symons's Meteorological Magazine*, July, 1911, Mr. William Ellis, F.R.S., discusses the widespread belief that the full moon possesses the faculty of clearing away clouds. This belief, which is expressed in the French proverb, "La lune mange les nuages" ("The moon eats the clouds") was held by Sir John Herschel, Humboldt, and Arago, but it has no foundation in fact.

Many years ago Mr. Ellis tested the question by examining the observations of the amount of cloud made every two hours at the Royal Observatory, Greenwich. Grouping together, during the period discussed, the observations on the five days about full moon, and similarly the five days about new moon, there was found in both cases to be, on the average, a maximum amount of cloud in the forenoon, and a minimum amount in the evening. Now, if from any cause there was found to be a greater dispersion of evening cloud under a full moon than at the time of new moon, the evening amount of cloud at full moon should be considerably less than that at new moon, but there was no significant difference, the amount at the time of full moon being slightly greater than at new moon; this giving no support to the supposition of lunar influence to disperse evening cloud.

The same result was arrived at a few years ago, but by a different method, by Rev. S. J. Johnson. He noted the state of the sky at moonrise and at midnight on the day of full moon for fifteen years. Of 186 occasions of full moon, in 126 there was a similar sky when the moon rose and at midnight; in 33 the sky was clearer about midnight than at moonrise; and in 27 the sky was more overcast about midnight; hence he found nothing to support the belief referred to.

The belief is easily explained. There is, on an average, a progressive diminution of cloudiness toward evening—quite regardless of the moon's phase. The physical explanation of this phenomenon need not be given here. It was set forth a few years ago by Dr. W. N. Shaw, in the *Quarterly Journal* of the Royal Meteorological Society. Now, the change from a cloudy to a clear state of the sky is much more likely to *be noticed* when occurring near full moon; for with no moon the disappearance of the clouds, though making the stars visible, does little to change the general aspect of the evening; while under a full moon the disappearance of the evening cloud changes the whole appearance of nature, and attracts the attention of the most casual observer.

Brightness of the Rising and Setting Sun

CAMILLE FLAMMARION undertakes to answer, in *L'Astronomie*, the following question, proposed to him by a correspondent: Why are our eyes less dazzled by the sun toward sunset than just after sunrise? Is the early morning sun really brighter than the late afternoon sun?

There are two answers; one physiological, the other physical. The retina becomes progressively more sensitive in the dark. A sudden illumination at night dazzles our eyes, whereas the same absolute intensity of light would have much less effect in the daytime. During the day the eye becomes gradually more and more accustomed to the light; in other words, less sensitive to it.

However, the setting sun is probably actually less bright than the rising sun, because of the diminished purity of the atmosphere through which it shines. Solar radiation pumps up an enormous amount of moisture from the earth during the day.

Abstracts from Current Periodicals

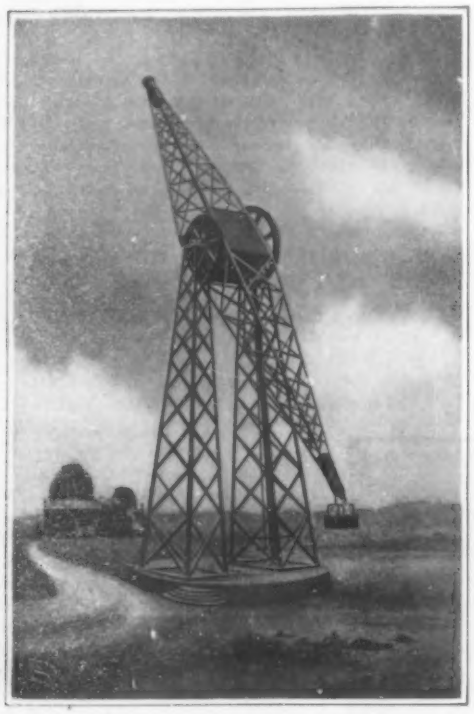
Phases of Science as Other Editors See Them

Open-tube Telescopes

IN an article published in the *American Journal of Science* Mr. David Todd discusses certain points in the construction of telescopes and suggests a plan for the building of an open-tube telescope presenting a number of novel interesting features.

All telescopes are made up of three parts: Object glass, eye piece, and some form of rigid mechanical connection between the two. Usually this last is a round tube, but there is no reason why it should not take any shape that the exigencies of mechanics or engineering may demand.

Many open-tube telescopes have been built. Huygens even built one with no tube at all. The objective was placed in a counter-balanced cell with universal joint, mounted at the top of a tall pole. He



Design for an open-tube telescope.

drew the axis of the objective into approximate line with the axis of the ocular by means of a cord or wire reaching down to the observer on the ground. No objective of modern optical excellence could ever be satisfactorily used in this way. The four-foot Melbourne reflector designed and built by Thomas Grubb has an open tube of spirally interlacing straps of steel.

The optical advantages of great focal length have long been understood. To fully avail one's self of these, it becomes necessary, however, to satisfactorily deal with the mechanical problems of appropriately mounting the parts of the telescope. In the large instruments of the present day, this problem presents no mean difficulties, and Mr. Todd starts out with the idea that a suitably designed open-tube telescope would best satisfy all conditions. The principal points to be considered in setting to work on the solution of this problem are, first, to build the tube so that its flexure shall be negligible, and, secondly, to mount the weighted tube so that it can be pointed with ease to any part of the sky. Mr. Todd says:

I have begun my projected telescope, not at the end, but in the middle, just as a bridge engineer builds a cantilever. (See the accompanying illustration.)

The basis of its tube is a cubical section or compartment of steel plates, reinforced as in box-girder construction, so as to be absolutely rigid and unyielding. For a telescope 200 feet or 300 feet long, I would build this central cube about 20 feet square. On two opposite sides it is perforated to allow the cone of rays to pass through; and on two other sides of the cube, at right angles to the cone of rays, are attached the circular bed plates of the bearing pins. In other words, tube and axis are the same in construction as the ordinary type of transit instrument, with shortened axis and a minimum distance between the pivots. Needless to say, this is the form which, in the evolution of transit and meridian circle, has been found to give minimum flexure.

As we are *per force* restricted to standard commercial forms of structural steel, the two halves of the tube must be built up, not as cones (the ideal form) but as square pyramids. As we have rotation about only one axis to deal with, the flexure of the great tube is easy to handle.

It will be apparent that the alt-azimuth type of mounting follows as a necessary consequence of this evolution; and the altitude motion gives no trouble whatever in either design or practical construction; it is only when we reach the azimuth motion that mechanical and engineering difficulties arise, though they are not wholly insuperable ones.

As we go downward from the telescope to the ground, our troubles increase; and they become a maximum when we reach the plane of junction between earth and mounting. Let us now consider the method of dealing with this problem.

What we want is an absolutely smooth positive and yet exceedingly easy motion of a huge vertical shaft. In order to meet those requisites, and treating it as a shaft simply, we should extend its length downward, and confine its motion as a journal between two horizontal friction rings, slipping between roller bearings on vertical axes. These rings, with perhaps 100 roller bearings for each, 50 outside and 50 inside, should have horizontal wheels or rollers of large diameter, ground to perfect cylinders. These rings are intended to operate only when the telescope is in use in the wind. When the air is still, a smoother azimuth motion would be possible if the friction rings are clamped motionless to the concrete well in which the vertical drum revolves.

Then I would float the entire structure in either oil or water, leaving only a few hundred pounds of load on a central button or pintle. In this way a clock of minimum power would suffice to drive a maximum load with perfect smoothness. The expanded vertical axis, then, would be a little like the inner tank of a gasometer when at its lowest point. It should be not less than 50 feet in length, or vertical height; and this drum-shaped form would afford an easy interior construction, insuring absolute rigidity of the vertical towers, which might go down through it, as far as thought best. No wind could ever topple the structure over, and the open-air telescope would be safely usable on all but the windiest occasions. By lowering the pintle underneath, and pumping out enough of the flotation to allow the drum to settle down to stationary beds, the drum could be rigidly clamped near the top and bottom, so as to withstand securely all stormy weathers when not in use. In case of a severe gale, the telescope would be pointed quartering to the wind, observing carriage and tail-piece unshipped, and tube directed to the nadir. Here the objective would be double-housed against the storm, and the cell clamped firmly. This would secure both bearings and open-air pyramids against harmful stress due to excessive wind-thrust, as the gale would strike the structure edgewise.

I have not intended in this paper to deal with the solution of any but the most general problems of this proposed telescope. All details have, however, been critically worked out, so that an approximate estimate of cost is available. A 5-foot objective would cost about $125,000, and the entire instrument would represent about double that amount. For instance, the weather protection of objective and eyepieces, of altitude bearings and of altitude clamp, quick motion and slow motion; also electric motors for operating the same in both coördinates, and for the requisite variable clock-motion in both altitude and azimuth, as well as for driving the rotary tail-piece on a ball-race. With this arrangement, and an adaptation of Prof. Ritchey's double-slide plateholder with independent rotary motion, micrometric work and even precision photography might be quite practicable. All the clamps and motions and clocks may be controlled by electric motors operated from triplicate switchboards in (1) the observing box, (2) the altitude house (not shown on the upright piers), and (3) from the azimuth room concealed beneath the basal drum.

In lieu of observing-chair or rising-floor, observer and assistant ride in a light carriage on the eye-end, swinging on a horizontal ball-bearing axis which passes through the focal plane. This may be wholly inclosed for weather protection, and it can readily be warmed electrically in winter. Should such an instrument ever be erected on a high mountain, as for instance, Fujiyama in Japan, 12,400 feet elevation, where a saddle within the crater provides an ideal location such that wind would rarely shake the telescope, it would be wholly feasible, in fact very easy, to supply the observing box with air artificially compressed to sea-level tension. Thereby we should avoid the disastrous effect of mountain sickness, which not only interferes greatly with one's comfort at elevations much in excess of 10,000 feet, but in consequence of the quickened pulse, tends to shorten the life span of anyone who persists in tarrying long at great elevations, without frequent return to safe and lower altitudes.

An Astronomical Method of Finding an Aeronaut's Position.

WHEN terrestrial objects are invisible, an aeronaut is compelled to employ indirect methods of finding his position. Several such methods have been invented during recent years. Berlingmaier and Marcuse have employed magnetic measurements for this purpose and successful methods of informing an aeronaut of his position by means of wireless telegraphy have been devised. Finally, astronomical methods have been proposed, in which the tedious reduction of the observations is effected by means of special apparatus.

An instrument of this character, invented by Voigt, is shown in Fig. 1, and the method of its use is thus

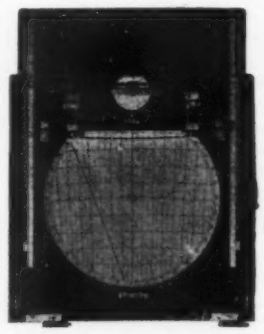


Fig. 1.—Instrument for finding aeronaut's position.

explained in the *Deutsche Zeitschrift fuer Luftschiffahrt*. The principle involved is illustrated by Fig. 2 in which *A* and *B* represent two church steeples rising from a level plain.

If the angle of elevation of the steeple *A*, as viewed from various points of the plain, is measured, we know that all points for which this angle has a certain value α lie on a circle *a* of definite radius, the center of which is the base of the steeple. Similarly, we know that every point at which the angular elevation of the steeple *B* is equal to β must lie on the circle *b*. Hence a point at which the elevation of *A* is α and that of *B* is β must be situated at an intersection of the two circles, i. e., either at *I* or at *II*.

The objects observed from the balloon are not steeples, but stars, and the variation of their apparent altitudes with the balloon's position is due not to absolute distance, but to the curvature of the earth.

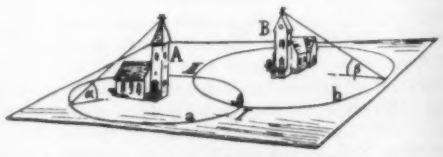


Fig. 2.—Map showing principle involved.

The altitudes of a number of reference stars, as seen at various hours from a definite point of the earth's surface, are first calculated. The point selected (50 deg. N. lat. and 10 deg. E. long.) forms the center and pivot of the revolving map shown in Fig. 1. With the aid of an accurate sidereal clock it is possible to draw the two circles on the map which determine the place of observation by their intersection.

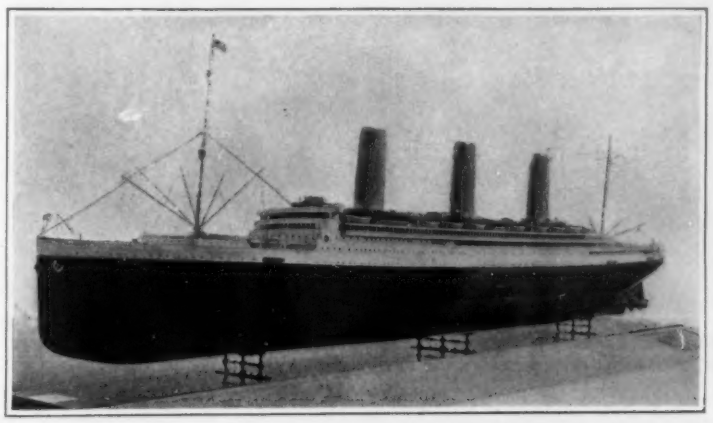
The drawing of the arcs is greatly facilitated by attaching to the map a curve-ruler which can be set accurately to the curvature corresponding to any altitude.

This method, of course, can be employed only at night in clear weather. The principle was employed in 1909 by Dr. A. Brill, who devised an instrument similar to Voigt's.

Curiosities of Science and Invention

Model of a Giant Steamship

IN the SCIENTIFIC AMERICAN of December 17th, 1910, we described the "Europa," now under construction for the Hamburg-American Line. This vessel is nearing completion, and in the meantime its name has been changed to "Imperator." A model of this vessel has been constructed, which is particularly interesting from the fact that it is one of the largest and most complete steamship models ever made. It will be recalled that the vessel measures 900 feet in length as against 860 of the "Olympic" and has a beam of 96 feet. It will carry 4,250 passengers, and some idea of this number can be obtained when we consider that the three largest hotels in New York city have a combined capacity of about 3,235 persons. The vessel is unusually commodious. It will contain a Ritz-Carlton restaurant, a grille room, tea garden and even a rathskeller. All of this will be shown in miniature in the 21-foot model. The model will be lighted with miniature electric lights, so that the spacious dining rooms, Roman baths and other features of the interior may be plainly seen.



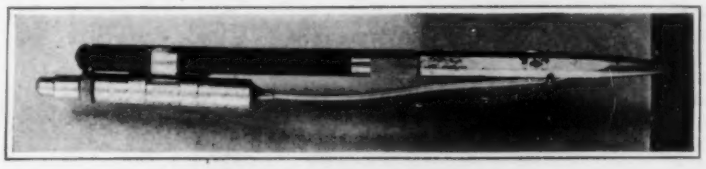
Twenty-one-foot model of the giant steamship "Imperator."

Propeller-driven Suspended Trolley Car

WHILE the use of a suspended car is not altogether new, yet the one now being tried out in Burbank, California, is unique in many ways. The chief point of interest is the fact that it is driven by a huge propeller, itself of novel design, which is operated by a 26 horse-power gas engine. The car is no mere toy model, but a fifty-foot structure of steel and aluminium, which has a carrying capacity of 56 passengers. It is built in a torpedo shape, and while the photograph shows the uncovered ribs, the finished car will be covered with a light, flexible covering, with celluloid windows. In addition to the propeller in the rear, another will be placed in the front of the car, doubling its power, and acting as an auxiliary in case of break-down.

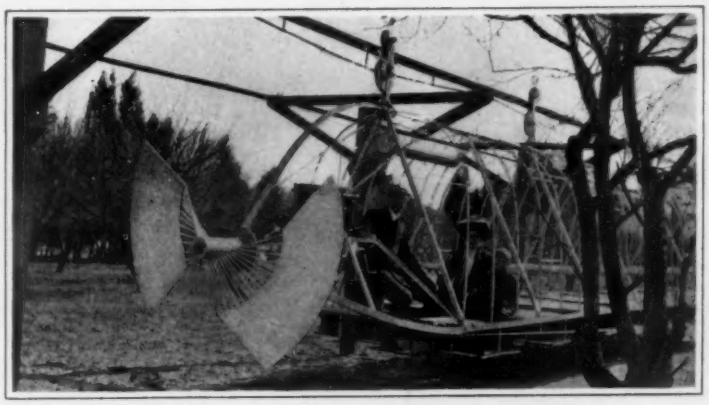
The short length of overhead track, about a quarter of a mile, has made it impossible to test the new device for speed, but it operates perfectly, showing that it is no mere theoretical invention. Forty people have been carried with ease at one time.

The six-foot propeller is of great interest, being a radical departure from accepted forms. It will be noted that the two blades are like enormous fans, being formed of sheet metal on ribs of steel tubing. A number of ingenious devices, tilting planes to lighten the car while in motion, apparatus for raising and lowering the car at stations, etc., have been designed to perfect this new vehicle.



Fountain pen for draughtsmen.

Propeller-driven suspended trolley car in California.



View showing the peculiar fan-like propeller.

An Aviator's Impromptu Bath

FLYING over water has always had a fascination for aviators, and with some of them the closer they can fly to the surface the better they like it. At the Boston meet last summer T. O. M. Sopwith, the winner of the $20,000 De-Forest prize for the first flight by an English aviator in England across the Channel to the Continent, played leap frog with the motor boats in the harbor, and greatly scared their occupants. He followed this up by performing similar feats with the automobiles on the Boulevard, and when he came across a horse the animal is said to have lain down on the ground in fright. While repeating this performance over water and scaring the bathers at Brighton Beach last September, Sopwith, who was accompanied by that other daring aviator, Lee Hammond, met his Waterloo. He was barely skimming the surface and had just risen to a height of 15 or 20 feet in order to fly back over *terra firma*, when his motor stopped and the aeroplane dived into the water. Both aviators jumped and escaped without becoming entangled in the wreckage. The aeroplane stopped bottom side up and completely submerged. Our photograph shows the skids, with their wheels, projecting slightly above the surface. The machine was towed ashore by motor boats. In a few days Sopwith had it fully repaired.

Sopwith's aeroplane submerged after its dive into the sea.

A Fountain Pen for Draughtsmen

A DETACHABLE container for drawing ink which can be slipped into place on the handle of a draughtsman's pen has been devised by a Los Angeles inventor, and by its use the constant dipping into the ink bottle is obviated. The danger of dropping ink upon the paper is avoided likewise. Another advantage is that a number of these containers may be carried in a pocket case, each of them holding a different colored drawing ink, for use in draughting maps, etc. Thus it is possible to dispense with a tray of ink bottles on the table. For filling this device, an ordinary "dropper" is used. As the photograph shows, the ink flows from the reservoir through a narrow tube to the pen point, where it supplies an even flow.

Meteorology in American Universities

MR. ANDREW H. PALMER calls attention, in *Science*, to the gratifying increase in the extent to which the science of meteorology is being taught in American universities. Students in medicine, engineering, agriculture and forestry are showing a growing interest in this subject, which until recently was conspicuous by its absence from nearly all university curricula.

At the University of Minnesota instruction in meteorology was first given four years ago. Last year the classes in this subject, under Prof. E. M. Lehnerts, numbered eighty-seven students, being the largest in this branch of science in the country. The University of Wisconsin has a separate department of meteorology, under Mr. Eric R. Miller, the official in charge of the U. S. Weather Bureau station at Madison, which is domiciled in one of the university buildings. Three courses are open to undergraduates, and four to both graduates and undergraduates. At the University of Nevada instruction in meteorology will be offered for the first time during the coming college year. The instructor will be Mr. S. P. Fergusson, late of the Blue Hill Observatory. The University of California is also about to inaugurate courses in meteorology and climatology, under Mr. W. G. Reed, Jr., who for some years past has been an assistant under Prof. R. DeC. Ward, of Harvard. The last university offers five courses in climatology and meteorology, one of which, a research course, is given at the Blue Hill Observatory by Prof. A. L. Rotch; the others at the university by Prof. Ward. At Williams College courses in meteorology have been given for several years by Prof. Milham.

There are a number of other universities and colleges, not mentioned by Mr. Palmer, at which brief courses in meteorology are given by local officials of the United States Weather Bureau, among them being the Universities of Missouri, Ohio, Tennessee, Nebraska, and Washington, Cornell University, Norwich University, and Drury College. At still other universities and colleges the officials of this bureau give frequent or occasional lectures. In fact, educational work in meteorology is recognized as one of the regular functions of the Weather Bureau, the personnel of which includes all the professional meteorologists of this country—with a few notable exceptions.

"And so we moved majestically out of Hampton Roads. As the flagship drew away, the vessels, in divisions of four, swung into line, until the fleet of sixteen battleships was strung out over some four miles of water."

A Landsman's Lo ship "North

By J. E

This landsman's log is written by the Editor zine Naval Number to appear early in December, with the Naval Number issued during the Spanis written entirely by prominent officers of the Nav The leading article, moreover, will be from the p Navy. The illustrations will consist of special p practice of the Atlantic Fleet on the Southern

IT is a far cry from a battleship, lying peacefully in port and "open to visitors," to a battleship at sea, developing over one million foot-tons of energy per minute as, with a savage roar, she flings some four tons of steel high into the air, to land with amazing accuracy upon a target, dimly discernible in the haze of the far horizon.

For many years it has been the aim of the SCIENTIFIC AMERICAN to make clear to the people of the United States, by pen and brush and camera, just what kind of a navy it is that flies our national flag. But photographs and printed statements of length, size and speed, serve, at the best, to give an impression merely material and technical. To understand what a battleship actually stands for, she must be studied from within and on the high seas. Then it is that the stupendous fabric becomes vibrant with throbbing life, and the inarticulate thought and skill that have been wrought into her at the designer's desk, and in forge and shop and dockyard, speak with many voices.

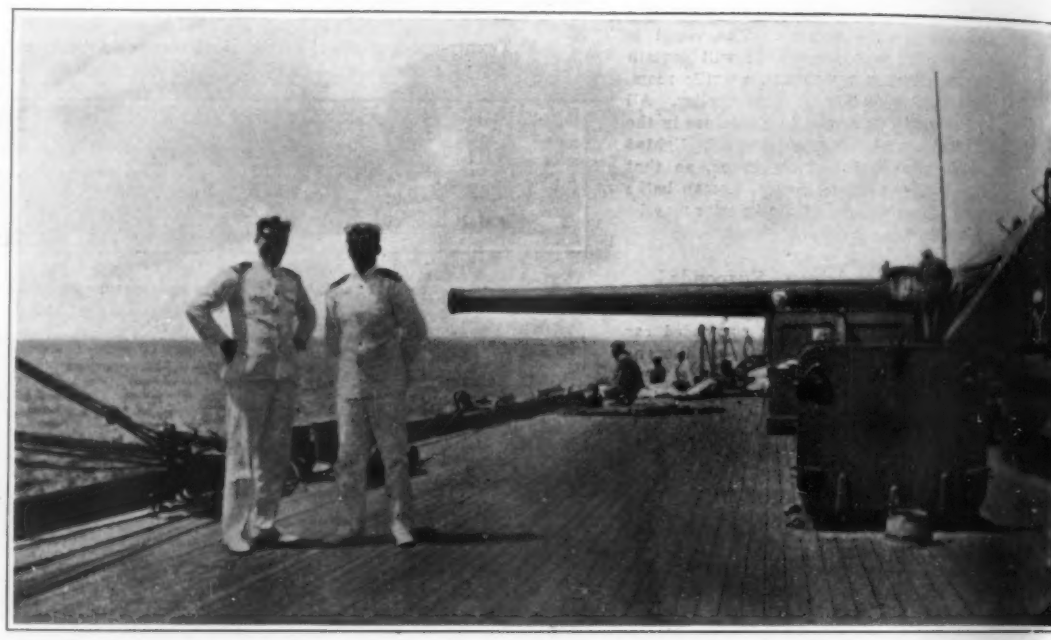
As with the ship, so with the men that man her "All the world loves a"—sailorman; but not all the world can understand him—the essentially human side of his life, the professional enthusiasm, the pride of ship, and his noble devotion to his country and his country's emblem, the flag. All this can be grasped only on those rare occasions when, as in the present case, a civilian is privileged, by the courtesy of the Secretary of the Navy, to make the ship at sea his home; sit at mess with its officers; mingle with its men; and absorb the atmosphere—unlike anything ashore—which pervades this highly-organized community of one thousand souls, shut up in its home of steel.

At least, so it seemed to the editor as he stepped aboard the particular steam cutter at Old Point Comfort wharf that carried the letters N. D. on its bow, and was taken to the gangway of that stately ship, the "North Dakota." The "North Dakota" was one of sixteen battleships that were awaiting the Admiral's signal to weigh anchor and proceed to Tangier Bay in the Chesapeake; there to watch the Delaware (sister to the "North Dakota") shoot away as much as she could of what was left of the old hulk, "San Marcos" ("Texas").

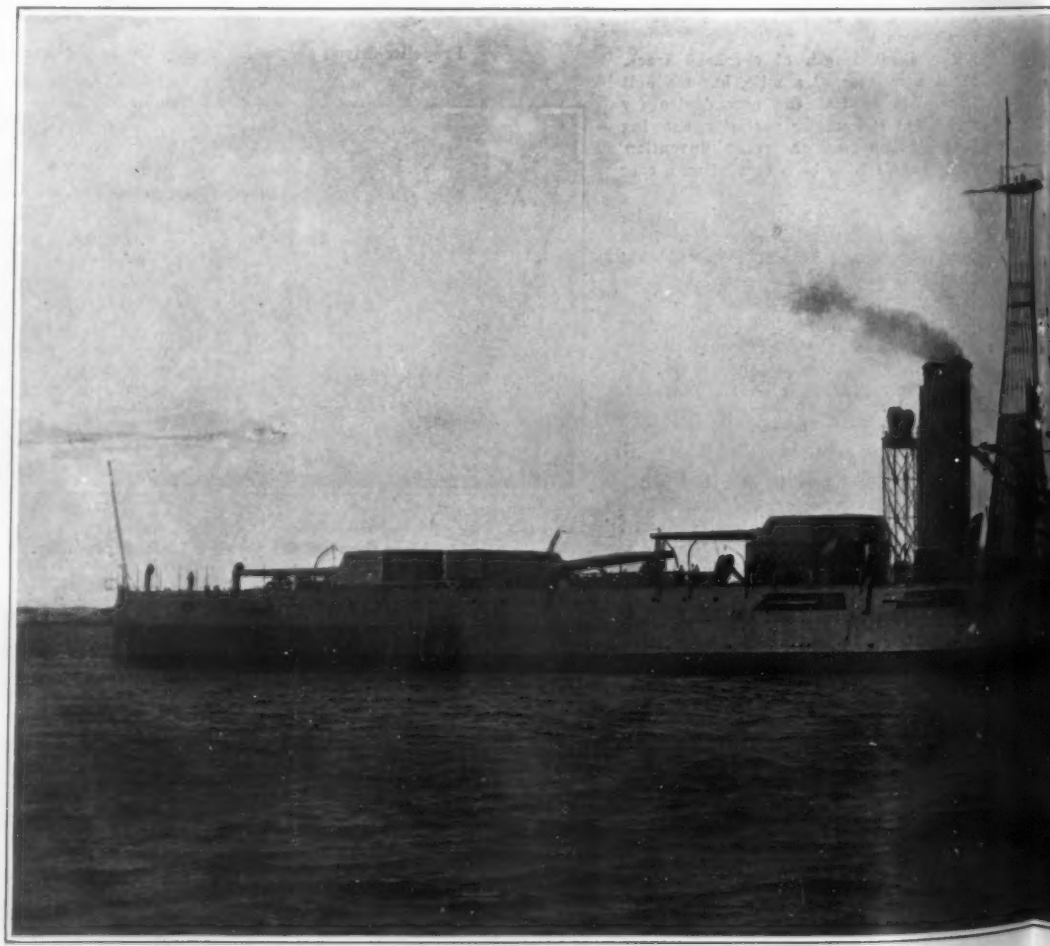
The spacious breadth and long, unobstructed sweep of the main deck of a dreadnought is suggestive rather of an ocean liner than of a ship of war—an impression which is deepened on the "North Dakota" by the yacht-like spotlessness of her deck. Here at least we see a survival of one of the traditions of the old three-decker; for the holystone and "washing-down" serve now, as in the days of Paul Jones and Nelson, to keep the man-o'-war'sman busy through many a long hour of the cruise. To that distinctively American plan, the center-line placing of the turrets, is due this fine vista of between three and four hundred feet of deck.

"Getting under way" is a very different matter from the picturesque confusion, so stirringly described by Marryat and Fenimore Cooper. Gone are the coils of rope, the rattle of blocks, the creaking yards, the flapping of canvas and the tramp of many feet around the capstan. Instead, there is the scarcely audible beat of the capstan engine below decks, and the "chug-chug" of the forty-pound cable links, as they come aboard through the hawsepipe and bring the flukes of the 10-ton anchor to their snug resting place under the bows.

We are the fourth ship in the first division, with the "Connecticut," flagship of Admiral Osterhaus, in the van. From sheer force of habit, I listen for the rhythmical throb of the engines as evidence that we are under way; but it is never felt, although a glance at the water shows that we are already moving at 10-knot speed. And then I remember that this ship is turbine-driven, and therefore tremorless as far as engine-room vibration is concerned.



"The spacious breadth and long, unobstructed sweep of the main deck of a dreadnought is suggestive rather of an ocean liner than of a ship of war."



Copyright 1909 by Enrique Muller

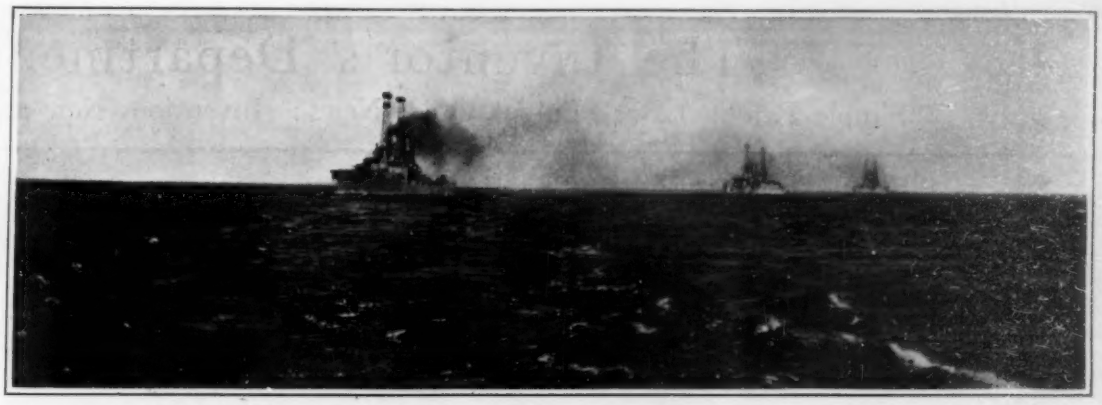
Length, 510 feet; displacement, 20,000 tons; speed, 21 knots. Armor: belt, 11-inch; upper belt, 10-inch; turrets,

THE "NORTH DAKOTA"—FIRST TURBINE-DRIV

s Log Aboard the Battle-North Dakota''—I.

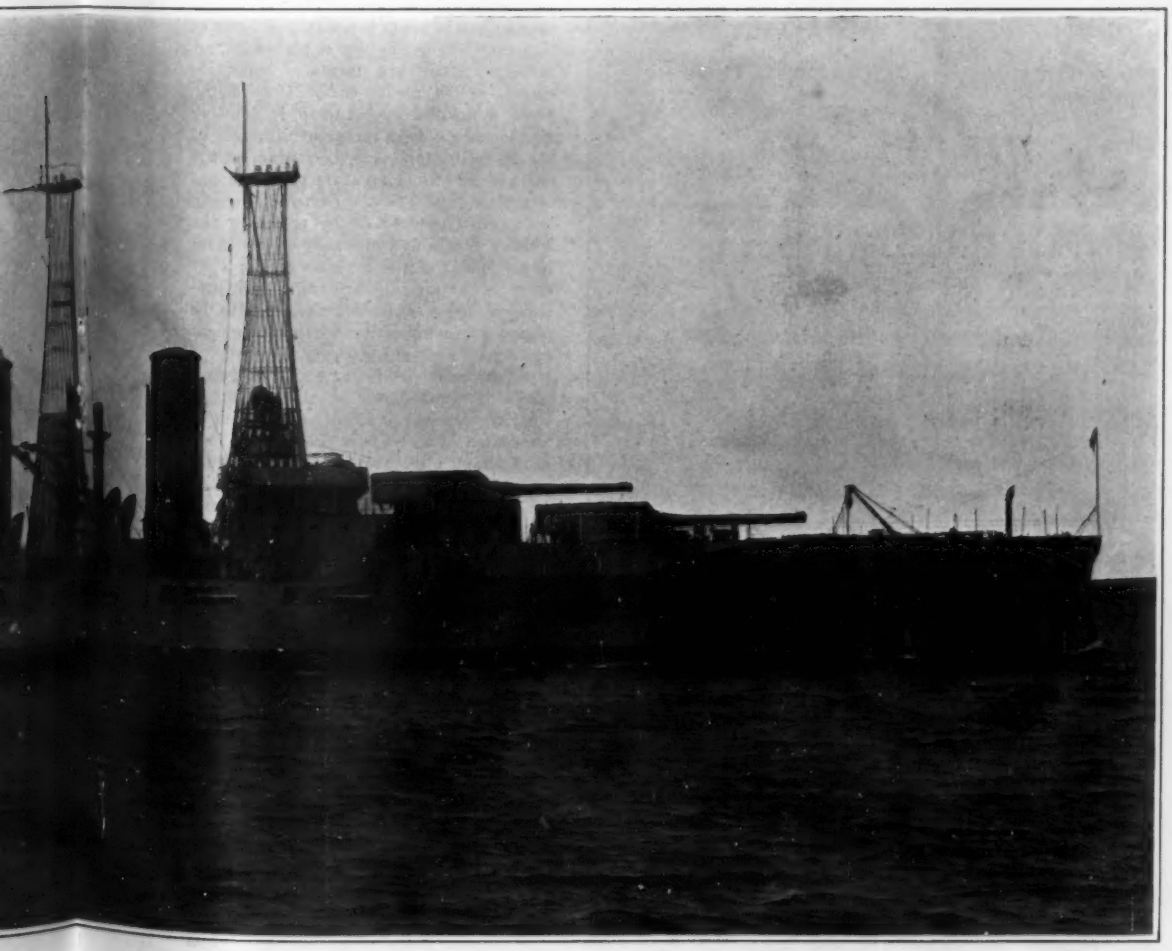
By J. Bernard Walker

the Editor of the Scientific American *as a preliminary to a maga- December, which will be comparable in its size and completeness the Spanish War. In one respect it will be unique, for it will be of the Navy, each a specialist in the particular field that he covers. from the pen of the Hon. George von L. Meyer, the Secretary of the of special photographs taken during the recent maneuvers and target Southern Drill Grounds.*



"Anyone who has handled the wheel in ships, big or small, will understand that it is no simple matter to hold sixteen vessels of fifteen to twenty thousand tons in absolutely true line ahead."

e rather "The holystone and washing down serve now, as in the days of Nelson and Paul Jones, to keep the man-o'-war's man busy through many a long hour of the cruise."



-inch; turrets, 12-inch. Guns: ten 45-caliber 12-inch, fourteen 5-inch. Torpedo tubes, two 21-inch submerged. Officers and men, 930.
URBINE-DRIVEN BATTLESHIP IN THE UNITED STATES NAVY.

Later I understood why it is that the turret officer and gun-pointer swear by the sweet-running turbine, and become impatient when they learn that Washington is still toying with the reciprocating engine and dreaming of pounds-per-horse-power economy. For the "North Dakota" was well aware that her sister-ship, the "Delaware," with reciprocating engines, was keeping station in that four-mile line of battleships, with forty per cent less consumption of coal than was needed for her own turbines. The matter came up for discussion in the wardroom mess. "Bear in mind," said one of the engineer officers, "that the 'North Dakota,' by a turn of the throttle and the opening of a few valves in the casing, can at a moment's notice jump her speed from ten to twenty-one knots, and keep going for hours at maximum power, with the same sweet certainty of motion, and without giving her engine-room personnel the least additional anxiety. And you know what happens," said he, "when a demand for full power is suddenly rung down from the bridge to the reciprocating engines of a battleship." The turbine has never been able to match the reciprocating engine in coal economy at the low cruising speeds; but when 15 knots has been passed, the difference begins to disappear, and at high speed the latest type of turbine (that of the "North Dakota" is of a rather early design) shows a greatly superior economy.

And so we moved majestically out of Hampton Roads. As the flagship drew away, the vessels in divisions of four swung into line, until the fleet of sixteen ships was strung out over some four miles of water. Five hundred yards from foremast to foremast was the distance, which was maintained by turning the propellers of each ship at the revolutions which had been determined in the standardization trials as correct for a 10-knot speed. The distance is also checked by triangulation, the height of the mast of the ship ahead being known and the angle subtended observed by stadimeter. In foggy weather each ship follows a towing spar, towed by the ship ahead at the end of a cable of the proper length. The speed is shown to the ship astern by cones hoisted on the signal yard, half way up for half speed, full up for full speed. When a change of speed is made, the cone is shifted accordingly—were it not for this the vessels might overrun each other.

Any one who has handled the wheel in ships, big or small, will understand that it is no simple matter to keep sixteen vessels of 15,000 to 20,000 tons in absolutely true line ahead, and hold them so for an hour at a time. But it was done so well that, from the taffrail of our ship, all that could be seen was the "New Hampshire," flagship of the division immediately astern, which, except at the changes of course, completely shut from view the three miles of ships beyond. No "snakes" are possible here; and when it is remembered that a battleship is generally far more difficult to steer than an ocean liner, the excellent work of the quartermasters of the Atlantic fleet will be apparent.

In the late afternoon we sighted the partly-sunken "San Marcos"—victim of to-morrow's onslaught—her broken masts and tilted smokestack giving her an appearance more tipsy than tragic. Signals flutter from the flagship, and the bits of gaudy bunting serve to scatter our hitherto unbroken line. In stately sequence the divisions swing out to port or starboard—the head of the line slows down—there is the crash of falling anchors—and the fleet moves, with an accuracy that is, to unaccustomed eyes, truly wonderful, into three parallel lines, and each ship, in its appointed position, is snugly anchored for the night.

And then, as the shadows deepen, there comes a transformation scene that will not soon be forgotten. The forbidding, dark-gray mass of each ship begins to sparkle with myriad incandescent lights, row above

(Continued on page 356.)

The Inventor's Department

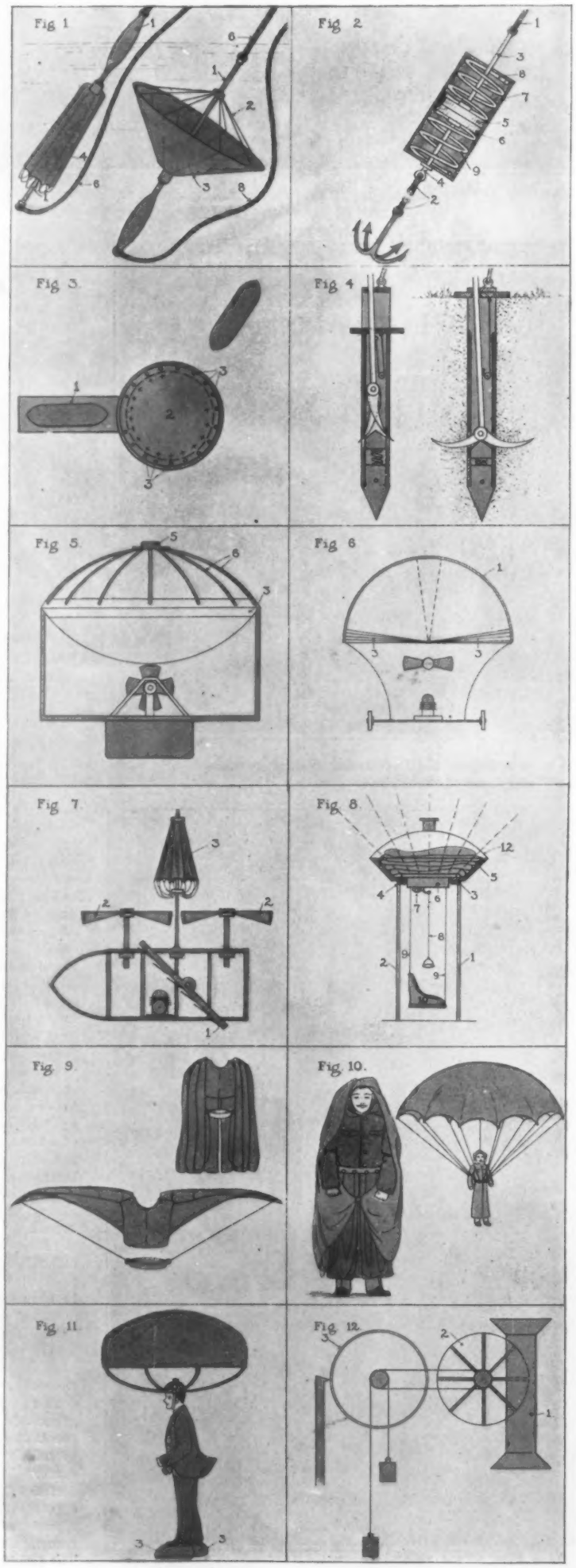
Simple Patent Law; Patent Office News: Inventions New and Interesting

Aeronautic Inventions, Curious and Useful

AERIAL and marine navigation, while in most respects totally unlike, are yet in certain particulars closely analogous, and this is perhaps most clearly observed in considering the smaller auxiliary devices relating to these arts. Although aerial navigation, so far as heavier than air machines is concerned, has only recently been accomplished, the art in a broad sense has been, nevertheless, the subject of patent applications for many years, and a consideration of these patents indicates that not only has inventive genius been active along broad lines of development, but that it has been busily engaged in the perfection of details of construction which now that so great interest has been aroused in the practical side of the art, may be found of great value.

While the first marine anchors were probably crude affairs, consisting of a rock or crooked branch, the art of aerial navigation did not arise until long after marine anchors had reached a fairly high state of development, and aeronautical inventors were thus able to confine their attention largely to the adaptation of these marine anchors to aerial use. Among the first patents granted in this country for an aeronautical device is that to one Bell, dated March 26th, 1850, which among other details shows a water anchor or drag, clearly adapted from marine use, and which, as illustrated in Fig. 1, consists of an umbrella-like structure 2, 3, 4, supported upon a rod 1, the rod being provided with ropes 6 and 8 at its opposite ends. It is evident from the construction shown, that, if the device be immersed in water and attached to the flying machine by the rope 8, the rope 6 being slack, the umbrella structure will remain closed and offer little resistance to travel through the water, while if the rope 6 be pulled taut and rope 8 be slackened, the pressure of the water will open out the umbrella device, thus presenting a large surface to the water and acting as a very effective drag or water anchor. Similar in type, but adapted for land use, is the device shown in the British patent to Alexander of 1893, in which a supporting rod similar to that of Bell's device is provided, but instead of the umbrella structure of the latter, the rod carries a series of backwardly projecting prongs or claws, which, when the rod is towed by one or the other of its ropes, respectively, slide easily over the surface of the ground, or engage with the same and act as a positive anchoring means.

In the year 1854, the Earl of Aldborough, one of the most enthusiastic promotors of aviation of his time, patented in Great Britian a flying machine embodying a multitude of ideas more or less practical, and among his many suggestions, describes an aeronautical anchor of peculiar form, evidently the result of an investigation of the anatomy of a bird's foot, and which he describes in the following terms: "I prefer forming the grapnels with flukes, attached to the stem by joints, and pressed downward by springs in such manner that the flukes shall strike downward when liberated, in a manner bearing a certain resemblance to the talons of a bird, separate cords being attached to each of the flukes, and all these being collected in a small sheath, and so arranged that the flukes can be raised, or permitted to spring downward by either fixing these cords in any convenient way, or letting them go when it is desired that the flukes shall act so as to enter the ground or seize any object." Apparently not satisfied with this device, he further perfected it in a patent of somewhat later date, wherein he describes a steel-sheathed cable for supporting the anchor, the cable being provided with a device for lessening the effect of sudden shocks, this latter feature being of very common use in marine navigation, being known in that art under the name of "shock-absorbers."



Some curious aeronautic inventions.

More clearly illustrative of this last feature is a patent to Fiesse, granted May 19th, 1908, which, as seen in Fig. 2, discloses a highly developed form of shock absorber interposed in the anchor rope of a flying machine, wherein the two portions 1 and 2 of the anchor rope are connected with the piston rods 3 and 4, respectively, extending from the pistons 5 and 6, the latter sliding in the cylinder 7, and normally forced toward each other by the compression springs 8 and 9. It is evident from the construction shown, that if the anchor rope be subjected to sudden shock, as by a heavy gust of wind striking the anchored machine, the two pistons will be drawn apart against the action of the springs, thus relieving the rope of the sudden strain.

In the patent to Mackenzie, granted in 1880, is shown an interesting development, wherein the shank of the anchor is provided with a snap-hook, for use, as the inventor states, in place of the anchors when stopping at regular landings, where rings will be provided for their reception. This leads to a brief consideration of aeronautical landing places or stations, and as in many other things aeronautical, the Earl of Aldborough, above quoted, appears to have been the first to make suggestions along this line. Among other things he suggested that such stations be provided with lights and signals for the proper guidance of the aeronaut, which suggestion appears recently to have been carried into effect in European countries. Along this line various patents have been granted, the proper protection of the anchored air ship being in general the main object, the patent to Fechtig, granted in 1910, being, perhaps, characteristic. This patent discloses what in effect is a modified locomotive round-house, having a turntable and radiating sheds, the turntable being inclosed, except at its ends. One of the great difficulties encountered in housing air ships, especially the great dirigibles of the Zeppelin type, has been due to the effect of side winds upon the great expanse of surface, and this the device of Fechtig is intended to obviate, by providing the inclosed turntable which may be presented to any point of the compass for the easy entry of the air ship, and which will protect the same while permitting it to be placed in juxtaposition to its permanent quarters.

A curious device for attaining the same result is that shown in the patent to Gothan, granted in 1910, and which is illustrated in Fig. 3, comprising a balloon shed 1, and a circular platform 2 in front thereof, the platform being provided with a series of vertical openings or jets 3, connected to a supply of compressed air. When these jets are all opened, a circular, vertical wall of air is created, thus effectually shutting out side winds. When it is desired to house a flying machine, the jets are cut off on the side from which the machine approaches, but as soon as the ship has passed through the opening thus formed in the air wall, the jets are again turned on, thus serving to fully protect the ship while being placed in its shed.

While the marine anchor is adapted more particularly for use in wet and relatively soft material, the aeronautical anchor must oftentimes encounter hard, dry ground, and, owing to its necessarily light weight, some modification of the marine anchor must obviously be made if the device is to prove successful. One of the simplest forms of anchor is shown in the patent to Myers, May 26th, 1885, con-

(Continued on page 348.)

ALCO
Motor Trucks

How to Judge a Motor Truck

BUYING a motor truck is like hiring a man. You are not interested in the color of his eyes, the tilt of his nose, or his height and weight.

You want to know what this man has done and what he can do.

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It's what a truck will do that interests you.

Price alone sells few trucks. It's what you "get for the money" that sells them. In other words *value.*

Four things determine value in a truck.

One of them is *good design.*

The only sure way to tell good design is by results.

If a truck is not well designed the owner soon knows. If it is well designed, and if he can use more trucks in his business, he buys more of the same make—naturally.

Thus you may judge a truck by the number of repeat orders or re-orders.

In the case of the Alco Truck 62 per cent. were purchased on repeat orders. Nine-tenths of this number are in the service of firms and corporations listed in Bradstreet's at over $1,000,000.

Before purchasing, many of these large firms carried on extensive experiments to determine which motor truck was best. If only *one* Alco had been purchased by each of these concerns, its place among motor trucks would be clear. But each of these bought more than one. The American Express Company has 40; the Gulf Refining Company 16; Gimbel Brothers 13; the Long Island Express Company 10; and so on. Among many the Alco has been accepted as the standard—all future purchases will be Alcos.

The second point on which value depends is the *experience* of the manufacturer.

Good design means little unless experience in building is back of it. The thing to know is "how long has the manufacturer been building trucks?" "What does the manufacturer know about the problems of transportation?"

For the American Locomotive Company, builders of the Alco Truck, the experience began in 1905. The Alco Truck was marketed in 1908. The experience of the American Locomotive Company in problems of transportation dates back to 1835 as movers of the world's goods.

The problems of the locomotive and the problems of the motor truck are parallel. One is a power driven vehicle running on rails. The other a power driven vehicle running without rails.

The experience of the American Locomotive Company, as builders of the Alco Truck, is rare.

Value is again determined in the *way the truck is built.*

Little does it matter how well a truck is designed if it is not well built. It becomes a consideration of factory and factory equipment.

The Alco factory represents an investment in equipment of over $4,000,000. In it are built 95 per cent. of the parts of the Alco Truck. It has the most complete heat treating plant of any motor truck factory in the world. It has large chemical and physical laboratories to analyze and test the metals that go into the Alco Truck. In special and automatic machinery the investment is immense—in jigs and tools alone the investment is over $2,000,000. Many of these tools are not tools in the ordinary sense of the word, but are fine instruments—like those of a surgeon—and are kept in flannel when not in use.

In this factory is the largest drop hammer in the world. It weighs 250,000 pounds.

The fourth consideration in determining value—and one that is most decisive—is the *responsibility* of the manufacturer.

The safest thing in the world to buy is reputation. Buying a truck from a manufacturer without reputation or reponsibility is like making a loan without security.

The American Locomotive Company is capitalized at $50,000,000. It dates back to 1835 as movers of the world's goods. It has built 50,000 locomotives. It builds 60 per cent. of all the locomotives in the world. Its reputation is indelible.

These four considerations—Good Design, the Experience of the Manufacturer, Good Building and the Responsibility of the Manufacturer—provide an "acid test" for judging a motor truck.

There are a few trucks that can stand this test.

Of these the Alco Truck is one.

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Capital, $50,000,000

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No-Rim-Cut Tires
10 Per Cent Oversize
With Double-Thick, Non-Skid Treads

They end rim-cutting forever. They avoid the blowouts due to overloading. They prevent skidding and do away with chains.

These No-Rim-Cut tires, in the past two years, have increased our tire sales by 500 per cent. Over 700,000 have been sold.

These tires now dominate the field. With tens of thousands of motorists they have cut tire bills in two.

Now they come with this ideal Non-Skid tread.

The Final Tire

After 12 years spent in tire making—after ceaseless improvements—we believe that the Goodyear No-Rim-Cut tire is now pretty close to finality.

Our greatest invention—controlled by our patents—has ended rim-cutting forever. That was, perhaps, your chief worry and expense.

By making these tires 10 per cent oversize—without extra charge—we added 25 per cent to the average tire mileage.

By 12 years of tests on tire-testing machines we have brought our formulas and fabrics close to utter perfection.

And now we have added a Non-Skid tread worthy of all the rest.

We never hope to see a much better tire than the Goodyear No-Rim-Cut today.

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Most of you know the No-Rim-Cut tire—the oversize tire—which has come to such immense popularity.

The control of this tire has thrice trebled our tire sales within two years. Its sales to date exceed 700,000 tires. And, to meet the demand, we are increasing our capacity to 3,800 per day.

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An Extra Tread

The Non-Skid feature is an extra tread, vulcanized onto our regular tire. Thus the tread is made double-thick.

This extra tread is exceedingly tough, as impervious to wear as a rubber tread ever can be. It remains effective over enormous mileage. When it does wear off there's our regular tread below it.

The tread is made up of deep-cut blocks, which grasp the road surface with countless edges and angles. The blocks widen at the base, so the load is spread over as wide a surface as it is with the smooth-tread tire. The grooves can't fill up.

This double-thick tread, because of its thickness, reduces danger of punctures by 30 per cent.

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Aeronautic Inventions, Curious and Useful

(*Concluded from page 346.*)

sisting merely of a circle of sharp pegs projecting downwardly from the bottom of the car and converging toward the center, thus when forced into the ground by the weight of the aeronaut, clutching a large section of earth and acting as a powerful anchor. Mr. Barnes, in a patent granted in 1892, has improved upon the above device to the extent of substituting long, corkscrew-like rods for the straight pegs and providing means for revolving these by power from his motor, thus obtaining a tremendous grip upon the ground.

Another form of earth anchor as illustrated in the German patent to Bonet, consists of a hollow shell having a pointed end and adapted to be forced into the ground, the shell being provided near its lower end with openings through which may be projected curved arms which enter the adjacent soil and thus obtain a powerful grip thereon. Similar, but with some modifications in structure, is the device shown in the patent to Thomas, dated July 24th, 1906, and illustrated in Fig. 4, the manner of operation of which is so obvious as to require no explanation. The acme of inventive ingenuity along this line must, however, be conceded to an Englishman, Mr. Jackson, who proposes to attach a cannon to the car of his machine and shoot dart-shaped anchors therefrom into the ground.

Among other interesting devices might be mentioned that shown in a patent to Lake, granted in 1908, in which is shown the car mounted upon three wheels, the two rear wheels being free to swivel in the manner of furniture castors, while the front wheel is provided with long spikes upon its periphery and may be held stationary when desired. When thus held, the spikes project into the ground, thus forming a pivotal point about which the whole structure is free to turn, and thus the machine will always head into the wind after the manner of a weather vane.

A device in which the anchor is put to a seemingly anomalous use is shown in a patent granted to Mueller, in 1909. Here the anchor is not used for the purpose of retaining the machine in a fixed location, but as a means for causing its proper ascent. In this case the anchor is held by an endless cable passing over pulleys on the machine. When about to start, the anchor is firmly embedded in the ground. Upon starting the motor, the machine endeavors to rise, but being restrained by the anchor, describes the arc of a circle about the anchor as a center until the cable becomes so nearly vertical as to release the anchor, when the machine is free to take flight, by this means permitting the machine to rise from its restricted quarters, and to pass over obstructions in its immediate vicinity.

As every well equipped marine vessel is provided with life-preservers and life-boats for use in emergency, so will the flying machine of the future be provided with means for assuring the safety of the aeronaut in case of accident to his machine, and in the provision of such means the inventor has not been idle. The majority of such devices are modifications of the well known parachute, but it is interesting to note the variations in and methods of adapting this simple device for use in connection with other aerial craft.

It is well known that if the gas be suddenly allowed to escape from a balloon when at a great elevation, the balloon envelope will, in many cases, assume of itself, a parachute form within its netting, and fall slowly to the ground. This fact has not been overlooked by the inventor who has endeavored to assure this action by giving the balloon a special form or construction, a typical example of which is seen in the patent to Chance, granted in 1908 (see Fig. 5), in which the balloon is of lenticular form, comprising a metal rim 3 to which the car is attached and provided with a set of rigid ribs 6 converging to a central collar 5. The upper and lower sheets of oiled silk forming the gas bag are attached to the rim 3. It is clear that if either the upper or lower sheet be accidently ruptured and the gas escapes, the material of the bag will be forced by the air pressure against the ribs 6 which will support it in parachute form and thus prevent a precipitous descent.

In a like manner, by taking advantage of a special form of aeroplane, the inventor has converted this type of machine into a more or less effective parachute, as for example in the French patent to Wold (Fig. 6), wherein an end view of the plane is shown. Here the main plane 1 is in the form of a half cylinder, open downwardly and at its ends. The ends of the plane are, however, provided with curtains 3, normally folded, but which may be extended to close the ends of the machine, thus forming a sort of parachute.

Of course only a specific type of aeronautical vehicle lends itself to the above construction, and so independent parachutic devices have been produced. Although the ordinary aeroplane has proved capable under skillful management, of descending safely from great heights without motive power, yet the inventor has made assurance doubly sure by providing the aeroplane with a folding parachute adapted to be spread in case of accident by the air itself, one of the most recent of these devices being that of G. F. Myers, in which the aeroplane consists of a series of super-posed ring-like or annular planes. Upon the upper of these planes lies a normally folded parachute attached by a series of restraining cords to the plane, and being also provided with a controlling cord. By pulling the latter, the parachute is drawn beyond the edge of the plane, permitting entry of air between the plane and parachute, the latter thus being expanded and rising to the full extent of the restraining cords.

The helicopter and flapping wing types of machine, however, seem to offer little chance of safe landing in case of failure of the motor, and as the inventors of this form of machine evidently expect them to go up, so they have, with great unanimity, provided them with parachutes to prevent them from coming down too suddenly, and of these devices, one of the earliest, patented to Quinby, in 1861 (see Fig. 7), is typical. Here the machine, which is of a composite type, having valved, beating wings 1, and helicopter wheels 2, is provided above the latter with a normally folded parachute 3, adapted to spread itself if the machine begins to fall and thus prevent too rapid descent.

While all the above devices have for their object the saving of the entire machine from the effects of a fall, attention has also been given to the provision of parachutes for saving the person of the aviator alone, and typical of such devices is that patented to Griepe in 1907, covering an air ship embodying among other features a trap door in the bottom of the car communicating with a compartment containing a parachute provided with a releasing device, whereby in case of emergency the operator may suspend himself from the parachute and abandon the air ship to its fate.

It is well known that parachutes cannot always be depended upon to open automatically when required, and to ensure their proper opening, M. Pichou has taken out a patent in France covering the device shown in Fig. 8, wherein 1, 2, indicates the frame of the flying machine, 3, 4, a circular connecting member, 5, a circular box resting on 3, 4, the box being provided with a central opening in its bottom, 6 is a receptacle filled with explosive and resting on the bottom of the box 5 and covering the opening, and 7 is a trigger operated by a cord 8 for detonating the explosive contained in the receptacle. Attached to the bottom of the receptacle by cords 9 is the seat 10 for the aeronaut, and attached by cords to the top of the receptacle and normally nested in the box 5 is a parachute provided with cover 12 to prevent the wind from disturbing it. In case of accident, the operator merely pulls the cord 8, thus exploding the charge in the receptacle, which ejects the parachute from the box, when it immediately becomes effective and pulls the aeronaut, seat and all, up through the ring 3, 4, and free of the falling machine.

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Of course most of the above devices require some preliminary action on the part of the aeronaut in order that the parachutic device may become effective, and in order to avoid this a still further arrangement has been devised wherein the parachute forms a part of the clothing of, or is attached directly to the person of the aeronaut. The Earl of Aldborough, before referred to, appears to have been the originator of this idea, and describes a parachute to be worn about the neck and reminding one by its general appearance of the old fashioned neck ruff, but of exaggerated proportions, and provided with stays leading to a belt at the waist. Of a very similar character are the devices patented to Wilke, in Germany, and to Mayer, in Great Britian, illustrated in Figs. 9 and 10, respectively, wherein the former shows a sort of vest embodying the parachute and having stays leading to the wearer's belt, while the latter shows a parachute attached to the aviator's coat and adapted to be folded over the head and shoulders when not in use, thus serving as an additional protection against the weather. A further modification is seen in the patent to Ulmer, January 31st, 1911, which consists of a hat for the aviator, provided with a pocket in which is folded a parachute the cap and parachute being attached by a cord to the aviator's belt. In the event of an accident to the machine, the aviator will immediately remove his hat, when the air current, caused by the descent, will inflate the parachute and the aviator will be saved all further cause for anxiety.

In passing, might be mentioned the device patented to Mr. Oppenheimer in 1879, and illustrated in Fig. 11. Although designated a fire escape, it would appear equally advantageous for aeronautical use, the padded shoes 3 being without doubt a highly desirable feature, especially in the estimation of the luckless pedestrian upon whose head the wanderer from space might chance to descend.

As in the operation of the submarine boat, it is of primary importance that the depth below the surface be always known, so in aeronauties it is of interest to know the height above the earth. Although many devices have been devised for registering the height or the vertical movement of flying machines, some of which have been noted in a recent number of this paper, the records of the Patent Office appear to be singularly devoid of such devices.

Among the few patents relating to this subject is that to Chaubassargnes, granted in France, which shows (see Fig. 12), a device for indicating ascent or descent, comprising a vertical tube 1, having flaring open ends, a paddle wheel 2, projecting into the tube, and an indicator wheel 3, having graduations upon its periphery and driven by the paddle wheel. When the machine is ascending the air enters the tube at the top, rotating the wheel 3 clockwise and moving the indicator wheel to indicate upward travel, while in descending, the reverse takes place.

A second device for the same purpose but of different construction is shown in another French patent, that to Briaccon, wherein a series of balls are allowed to fall upon a resilient support carrying an arm provided with a pencil, which last rests upon a constantly rotating, paper-covered drum. It is stated that so long as the machine remains at a given level, the trace of the pencil upon the drum, caused by the impacts of the falling balls will lie in a straight line, but if the machine commences to rise the falling balls will strike the support sooner than when the machine is stationary, thus causing the pencil trace on the drum to vary from the normal straight line, the new pencil trace being above the normal, while if the machine should descend, the reverse operation will take place.

Along somewhat the same line may be noted the device patented to Pennington in Great Britian in 1896, wherein a mercury barometer controls, through an electrical circuit, the direction of thrust of a screw propeller, and by this means serves to keep the machine at the same level, and

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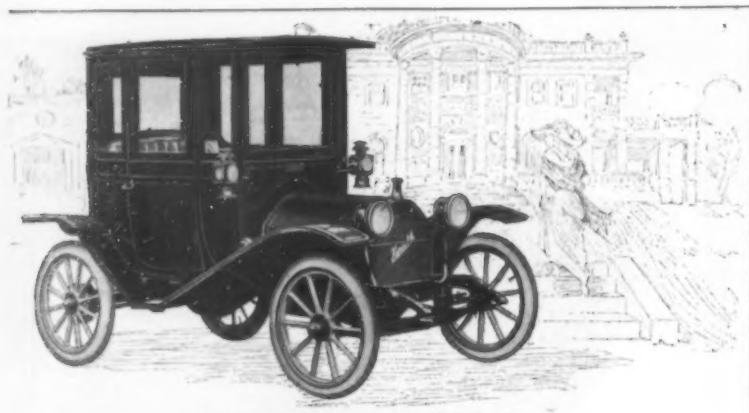

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the somewhat similar mechanism patented by M. Phillippeau in France. This embodies a suitable case containing a spring-driven winding drum upon which the valve cord of the balloon wound, the rotation of the drum being normally prevented by a friction brake. Mounted also within the case is an aneroid barometer, the indicator arm of which serves to make and break an electric circuit in which is included a magnet, the armature of which forms the aforesaid brake for the spring drum. When the balloon reaches a predetermined height, the barometer arm rises and completes the circuit thus withdrawing the brake from the drum and allowing the latter to revolve, thus opening the valve and permitting the gas to escape. The purpose of this device is to prevent accident due to the failure, or inability of the aviator to open the valve at the proper time.

The self-registering aneroid barometer, in its ordinary form, appears to be capable of registering the ultimate height attained, provided this height is maintained for an appreciable time, and so far as the writer has been able to ascertain, none of these devices having any special modifications of structure for aeronautical use has been made the subject of a patent. It would appear, however, that devices of this character might be devised especially for aeronautical use, embodying great rapidity and sensitiveness of operation, together with freedom from the effects of motor vibration, and at the same time having indicators and scales of such size as to be readily discernable from the operator's seat, and doubtless as the art becomes more highly developed the demand for such instruments will be fully met by the active mind of the inventor.

An Inventor as a Congressman

IT is of considerable interest to inventors to know that the House Committee on Patents includes in its membership a man of such experience in patent matters, as an inventor and patent lawyer, as William H. Wilder, in view of the flood of bills that are being presented to the Committee with all kinds of changes proposed to our present patent system.

Mr. Wilder was born May 14th, 1855, in Belfast, Me. His inventive ability was probably derived from his father and grandfather, who were mill men, his mother being a school teacher. At eleven years of age he removed to Massachusetts, worked on a farm; went to school in the winter, and was, in turn, a wood chopper, worked in a card mill, prepared chair stock for the chair factories of Gardner, and when but a little over sixteen, went into business for himself as a painter, and has been an employer ever since. While in the painting business he climbed most of the meeting-house spires in and around Gardner. He entered the oil stove business in a small way, and in the first years of his experience he made the patterns and all the other parts, and directed personally the making of tools and dies and the like, for a period of twenty years. He has taken out more than fifty patents covering his own inventions.

Mr. Wilder is a member of the Bar of the Supreme Court of the United States. His inventions have revolutionized the oil stove industry; for he is the inventor of the modern oil stove. He has taken great interest in denatured alcohol, having visited Germany to investigate this business.

During a period of thirty-eight years as an employer of labor he has never had a strike, lockout, or disagreement with his employees.

Notes for Inventors

A Folding Step for Street Cars.—The Public Service Commission for the district in which New York is included, has been considering the betterment of the equipment of surface cars. The Metropolitan system is now experimenting with a folding step for the pay-as-you-enter type of cars. The present step is too high, and there have been some accidents.

United Shoe Machinery Patents.—How huge is the part played by patents in the remarkable industrial development which

LEGAL NOTICES

PATENTS

If you have an invention which you wish to patent you can write fully and freely to Munn & Co. for advice in regard to the best way of obtaining protection. Please send sketches or a model of your invention and a description of the device, explaining its operation.

All communications are strictly confidential. Our vast practice, extending over a period of more than sixty years, enables us in many cases to advise in regard to patentability without any expense to the client. Our Hand Book on Patents is sent free on request. This explains our methods, terms, etc., in regard to PATENTS, TRADE MARKS, FOREIGN PATENTS, etc.

All patents secured through us are described without cost to the patentee in the SCIENTIFIC AMERICAN.

MUNN & COMPANY
361 BROADWAY, NEW YORK
Branch Office, 625 F Street, Washington, D. C.

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Advertising in this column is 75 cents a line. No less than four nor more than 12 lines accepted. Count seven words to the line. All orders must be accompanied by a remittance.

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FOR SALE—Twenty acres of a deposit of very fine fire clay on the line of the Railroad. For further information and terms apply to Wyatt & Company, New Decatur, Alabama.

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LOCAL REPRESENTATIVE WANTED.—Splendid income assured right man to act as our representative after learning our business thoroughly by mail. Former experience unnecessary. All we require is honesty, ability, ambition and willingness to learn a lucrative business. No soliciting or traveling. This is an exceptional opportunity for a man in your section to get into a big paying business without capital and become independent for life. Write at once for full particulars. Address E. R. Marden, Pres., The National Co-Operative Real Estate Company, L 378 Marden Building, Washington, D. C.

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FULLY QUALIFIED ENGLISH ENGINEER (A. M. I. C. E.), situate in London, already acting as representative for a few good firms, is prepared to undertake English Agency for one or two good specialties. Experienced also in negotiating the sale or license of British Patents for successful finished inventions. Address, Engineer, Box 773, New York.

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BEST DOUBLE POWER PLANT AEROPLANE. One of the five entrants to the Gould Prize Contest. Has also automatics, stability and dangerous dive preventer; other new features unequalled. First machine, half prize and two patent rights as insurance or collateral for capital to build and ship, or in view of other pressing interests and duties, will sell or deal with manufacturing firm. Edward J. Elsas, Inventor, 228 W. 16th St., Kansas City, Mo.

UNIVERSAL ATTACHMENT and drive for boring tools. All drills and bits instantly adjusted in all driving sockets, etc., without screw or movable part. Many advantages. Cannot be equalled. Royalty, or party to open company to manufacture all or part. First principle—see patent No. 1,001,376. E. J. Elsas, Kansas City, Mo.

THE MOST WONDERFUL BOOK on human language ever written is ready for the press. Original—each letter a meaning. Spelling vindicated. Many mysteries cleared. Investor, publisher or printer wanted—share. E. J. Elsas, author, Kansas City, Mo.

this country has undergone in the last half century is shown by the prosecution of the United Shoe Machinery Company. This "trust" owns at least a thousand and possibly fifteen hundred United States patents. A mere list of them alone covers 54 pages of legal cap. In some instances many patents have been granted to one inventor. John B. Hadaway has received about 76 patents, and Thomas G. Plant also a large number. The "trust" also owns hundreds of foreign patents.

A New Hose-supporter Wanted.—A man of our acquaintance says he does not like a hose-supporter which encircles or grips his leg or one that is connected with and drags down on his undergarments, both such forms being on the market. Cannot someone invent a supporter that will hold the top of a sock up and avoid both of the above described objectionable features?

A Machine for Making Imitation Stitches.—John B. Hadaway of Brockton, Mass., assignor to United Shoe Machinery Company, has secured three patents, No. 1,003,450 to No. 1,003,452, for machines for making impression or imitation stitches. The patent, No. 1,003,450, has an indenting wheel which is rolled back and forth over the work and is also caused to feed the work during its rolling movement. The patents, Nos. 1,003,450 to 1,003,452, were issued September 19th, 1911, on applications filed, respectively, July 18th, 1904, September 16th, 1904, and March 22nd, 1905, so that the applications were pending in the Patent Office from six to seven years. This inventor, John B. Hadaway, is one of the most prolific inventors in the shoe machine art and was the patentee of a patent, No. 521,978, for a machine for the same general purpose as the three above specified. The patent, No. 521,978, was granted June 26th, 1894, and consequently expired last June. The application on which this expired patent issued was filed in the Patent Office March 28th, 1894, and as the patent issued June 26th, 1894, the application was pending less than three months, in striking contrast to the three patents just issued.

Protecting from Electrolysis.—Albert B. Herrick, in a patent, No. 1,003,604, describes a method of preventing an earth conductor adjacent a grounded return by alternately connecting the earth conductor to the grounded return and to a source of negative electromotive force.

Sterilizing Earth Around Posts.—Patent post holes have long been humorously referred to in connection with machines for grinding smoke, left-hand wheel barrows, and other imaginary inventions. It has remained, however, for a Budapest inventor to make what is probably an important improvement relating particularly to post holes, seeking to thus preserve the wood of the posts. Instead of applying preservatives to the wooden posts, railroad ties, sleepers or other wood exposed to the action of the earth, he treats the earth which surrounds the wooden post in such manner as to destroy all insect, germ and fungus life by soaking the earth with a suitable sterilizing liquid. The process is termed "Peristerilization," and is claimed to be especially useful in rural and other remote districts in which it is inconvenient to obtain wood which has been treated with creosote or similar preservative.

Cork Plugs for a Novel Purpose.—Cork plugs are utilized in a cotton gin roller, patent No. 1,002,842, to William H. Harriss of Pawtucket, R. I., assignor to Empire Duplex Gin Company of New York city. The roller has a number of radial recesses, and the plugs of cork are fitted in the recesses and project beyond the surface of the roller. The cork plugs are described in the patent as constituting the operation friction surface of the roller, and the construction is inexpensive to manufacture and is otherwise advantageous, since the cork plugs being fitted to the recesses, may be readily renewed when worn or damaged.

A Novel Motor-controlling Improvement.—The operation of an electric motor as a series motor, and then as a cumulative compound generator when the motor is overhauled by the load, is the purpose of patent No. 1,003,431, to Alexander Churchward of New York city, assignor to General Electric Company. In securing the desired result, Mr. Churchward provides the motor with a series and a shunt field winding, and means for connecting the motor as a series motor for running and for connecting the shunt field winding in circuit and for reversing and shunting the series field winding when the motor is regenerating.

A Coaster Bar for Roller Skaters.—What is termed a roller-pole toy has been patented, No. 1,003,537, to Thomas S. Spivey of Cincinnati, Ohio. It consists of a pole, having a roller at one end and a handle at the other end, the rider sitting astride the pole on a seat. In front of the rider there is provided on the pole a cross bar between the seat and the handle, the knees of the rider bearing below the brace bar, so that when the rider is sitting, much of the weight is taken off the handle.

A Fireworks Auxiliary.—In patent, No. 1,003,411, to Haden Herbert Bales of Ashcroft, British Columbia, we find an airship frame with a battery of pyrotechnical rocket cylinders, adapted to operate as an auxiliary to the main propelling mechanism. Means are provided for adjusting the position of the rockets to regulate the direction of the discharge, and also a selective mechanism for firing any particular one or all of the rockets, as occasion may require.

An Illusion Apparatus.—A patent, No. 1,003,905, with Roy McHill of Somerville, Mass., as inventor, is for an apparatus for producing an illusory effect, in which a vessel is supplied with water from a pipe discharging from above and an exhaust pipe leaas upward from the vessel into the first pipe so it is hidden by the water discharged into the vessel, a pump, out of sight, being suitably connected with both pipes to properly circulate the water.

Three Patents to Charles Francis Jenkins.—Charles Francis Jenkins of Washington, D. C., has secured patents, No. 1,003,750, for a gas engine starter; No. 1,003,751, for a railway tie of metal and concrete with a special rail gripping device, and No. 1,003,752, for a gas motor starter.

Legal Notes

A Void Patent.—The Regnier patents, No. 678,514, for a vegetable or fruit slicer and method of making the same, and No. 744,107, for a slicer to produce such slices, *Held* void for prior public use. Handy Things Company v. Tucker & Dorsey Manufacturing Company (C. C. A.), 188 Fed. Rep. 68.

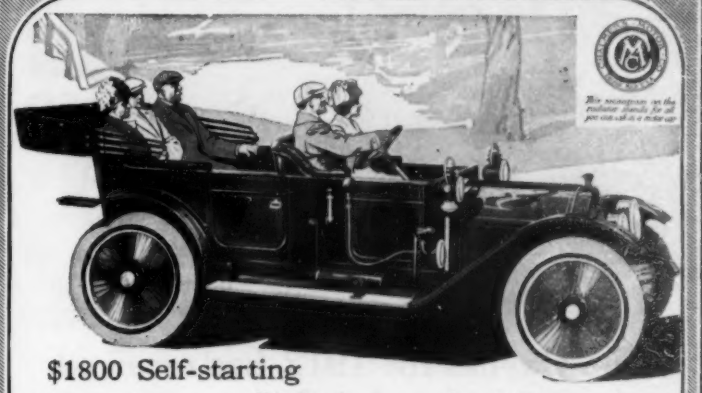
Substantive Patent Law and Procedure.—In a hearing last year before the Patent Committee of the House of Representatives, one of the most distinguished patent lawyers of the country said, in commenting on the substance of the patent law and the practice thereunder, as follows:

"The patent law, the substance of the law, in this country I think is admirable. I do not think there is any branch of law where the substance is in better shape than in the patent law to-day. When you come to procedure, that is, the way in which cases are tried, nothing could be worse."

Warning to American Trade-mark Proprietors.—In a note, published by the Bureau of Manufactures, American Minister John B. Jackson, Habana, Cuba, gives a warning and extends some good advice to owners of trade-marks, as follows:

"Under the provisions of the existing Cuban law with respect to trade-marks any person whatsoever can legally register well-known foreign trade-marks and deprive the foreign owners of such trade devices of the benefits arising from their possession. This has happened recently in several instances involving patent or proprietary medicines. When the third party has once registered the trade-marks in due form under the law the only redress possible for the rightful owner or originator is to bring action for fraud, and proof of fraud is naturally very difficult under such conditions, even in the most obvious cases.

"The registration of trade-marks is a simple and inexpensive matter in Cuba, and rightful owners may easily prevent difficulty by having their trade-marks registered at once whenever there is any likelihood of entering the Cuban market. It is urged that American manufacturers take note of this matter and by forestalling the registration of their trade designations by strangers in the island avoid future trouble."



$1800 Self-starting

Chalmers "Thirty-six" Leads

Our "Thirty-six" was the first medium-priced car to have these features:

Self-starting device
Does away with cranking. Simple air pressure type. Nothing complicated—just press a button on the dash and away goes your motor.

Genuine long stroke motor—4¼" x 5¼"
Means better pulling, longer service, greater quietness, freedom from vibration.

Five speed transmission—four forward speeds and one reverse
Gives utmost flexibility of control and enables you to climb the steepest grades with speed.

Dash adjustment for the carburetor
You can get the proper mixture to suit the varying weather conditions without getting out of car and lifting the hood.

36" x 4" tires and Continental Demountable rims
These big tires do away with tire trouble and insure ease of riding. Demountable rims rob punctures of their terrors.

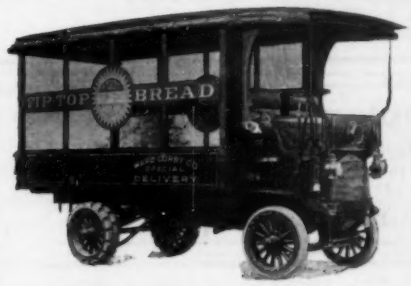
Genuine honey-comb radiator, cellular type
Same radiator found on highest priced cars. Means perfect cooling, longer life, good looks.

Bosch dual ignition
Simplest system yet devised. Nothing equals a magneto for furnishing perfect ignition.

(Read that over again. It is hard to realize at one reading that all these big features are really present in one car selling for $1800)

The famous Chalmers "30" is continued for 1912, representing even greater value than ever before. The price, $1500, includes magneto, gas and oil lamps, Prest-O-Lite tank, top and windshield. The Chalmers "Forty" at $2750 is continued for those wishing a 7-passenger car. See these cars at our dealers. Catalog on request.

Chalmers Motor Company, Detroit, Mich.



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"Mack" Superiority

IF it were possible for us to take every prospective truck buyer through our immense plant at Allentown, and show him how conscientiously and substantially "Mack" trucks are built; have him see every process, from the selection of the raw materials to the final coat of paint to the finished product, and last but not least, to see for himself the rigid "third degree" test over hill and valley which every "Mack" truck must undergo, before delivery to the buyer, then he would realize—as thousands of representative business firms do—that the "Mack" is truly

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The ease and economy of operation, the power to extend your commercial area, the manner in which a "Mack" outstrips competition is left to be told in a highly illustrated catalogue which will be cheerfully mailed upon request.

Mack Bros. Motor Car Company

Sales Offices and Show Room
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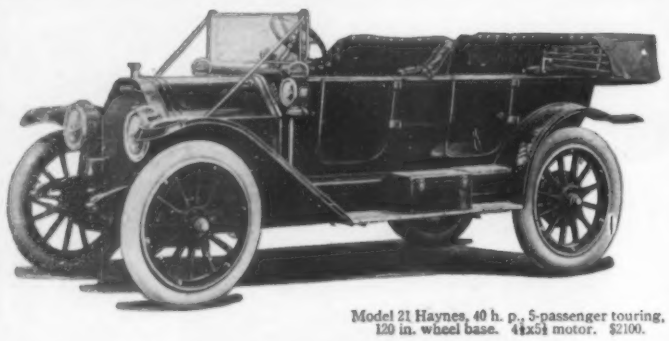
Main Office and Shops
Allentown, Pa.



Model 21 Haynes, 40 h. p., 5-passenger touring, 120 in. wheel base. 4½x5½ motor. $2100.

The Haynes for 1912 has received a royal welcome

IF ANY further evidence of the place which the Haynes car holds in the minds of the discriminating public were needed, it was furnished by the overwhelming response to our announcement of the 1912 Haynes.

By reason of the fire which completely destroyed our old factory last February, the Haynes car virtually had been out of the market for seven months. During those same months, other manufacturers were going to the public day after day, month in and month out, with their advertising, with their salesmen, and with their announcements of new models while *we* were at a standstill.

Last month, when our magnificent new factory had risen from the ashes of our old one, when its wonderful modern equipment had been installed and our first 1912 model had been built and tested and *proven* to be the *best* of all the splendid Haynes models ever built, *then* we came back into the market. It was a glorious return and the welcome has been beyond all expectation. We hadn't realized it but the public was *waiting* for the new *Haynes.*

The 1912 Haynes—two chasses, Model 21 and Model Y, 50-60 h. p., eight types of body—is a superb, high-power car, and built into it are eighteen years of Haynes experience and skill. Prices, $2100 to $3900. We also continue building our popular Model 20 in four bodies, prices $1650 to $1800. See the Haynes dealer now, or write for catalogue at once.

HAYNES AUTOMOBILE COMPANY
Dept. E KOKOMO, INDIANA
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Detroit Aeroplane Model 1912

Price $300, including Bosch Magneto, Schebler Carburetor, and Propeller. Ready to Run and Guaranteed to Fly. Bleriot XI, Demoiselle, Nieuport. Morane, Grade Monoplanes, and Curtiss and "Baby" Wright Biplanes.

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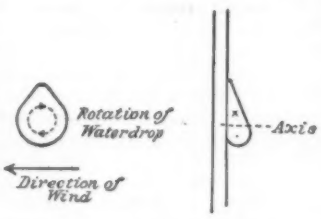
Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

Whirling Rain Drops on the Car Window

To the Editor of SCIENTIFIC AMERICAN:

On a rainy day the observing traveler will doubtless be surprised to find that every rain drop on the car window by his side becomes a miniature whirling vortex as long as the car is in motion at speeds above ten or fifteen miles per hour. The effect is most easily noticed when the rain drops have collected enough fine particles of soot to make their motion apparent. While the largest drops show the greatest movement, the rotation can be detected even in droplets down to one-eighth inch in diameter



when the train is running at high speed. The direction of rotation for each individual drop is the same as that of the car-wheels, the cause of the motion doubtless being due to wind friction against the lower rounded side of the water drop. The pear-shape form of the drops, especially the larger ones, where the attraction of gravity for the mass gets the better of the surface tension, which tends to hold the spherical form, results in a greater rotational moment at the rounded bottom than at the thin, wedge-like top, so that the wind friction at this lower surface produces movement in the same direction as the car wheels below.

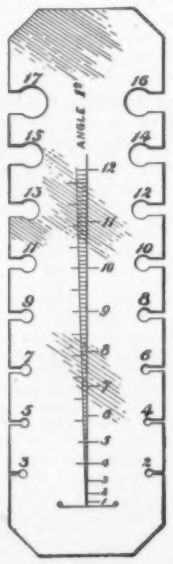
O. H. C.

Chicago, Ill.

Metric Wire Gage

To the Editor of SCIENTIFIC AMERICAN:

From a very reliable source I learn that the Committee on Weights and Measures of the next Congress will report a bill doing away with our old-fogy system of having different-size measures for different articles. For instance, we have a large quart for berries, beans, peas, etc., and a smaller quart for liquids. In the matter of weight we have avoirdupois, apothecary, and troy, no two of which are alike. Equally absurd as the above is the great number of non-standard wire gages, none of which has a base that is get-atable as a starting point, and no two that agree thereafter. To overcome this "conglomeration" in gages, the writer some time ago designed one (for both metal and wire), that is standard throughout. It takes for its base the same angle (of one degree) upon which the metric system of measure-



ments is founded. It starts at the apex of this angle for its first member, and gives it as No. 0, which it really is, for no substance, however small, can enter there. To locate No. 1, we measure along either side of the angle one millimeter; for No. 2, measure two millimeters from No. 1; for No. 3, go three millimeters from No. 2, and so on *ad infinitum.* It will be noticed that each gage number indicates the number of millimeters intervening between that number and the next smaller one below, and that every number is of good commercial size.

To illustrate its practicability, suppose a party in some isolated place had a piece of wire and wished to order more like it, but had no gage. All he would have to do would be to lay out an angle of one degree, insert his wire and measure the number of millimeters from its point of contact to the apex of the angle, then point off the gage numbers as above, and he has the exact size—a thing that cannot be done with any other gage made.

The accompanying drawing plainly shows for itself. The engraved angle in the center is exaggerated for purposes of illustration, but it represents an angle of one degree, on one arm of which are millimeters, and on the other the gage numbers, engraved simply to show the principle of the system, while on its outer margin are the usual slots cut out for the different sizes, with the gage numbers at each separate slot, all of which is as simple as "rolling off a log."

MERRITT W. GRISWOLD.

Highwood, N. J.

Twenty-seven-knot Armored Cruisers Urgently Needed for the United States Navy

To the Editor of SCIENTIFIC AMERICAN:

Having just read in your issue of July 22nd your most interesting comparison of the United States and German navies, I would like to have your explanation of the policy of the United States navy, which omits the dreadnought armored cruiser type as found in the British and German navies, and of which type Japan is now said to be building more than the battleship type.

With even one ship of the British "Lion" type, an admiral in charge of our ten dreadnoughts of the "Texas," "Wyoming," "Utah," "Delaware," and "Michigan" classes, could send his one 30-knot dreadnought to locate the enemy. Our light 24 to 26-knot scouts of the "Chester" class, and our 22-knot armored cruisers of the "Washington" classes, would obviously be completely at the mercy of British, German, or Japanese dreadnought cruisers of 28 to 30 knots speed, and it would be murder to send our good fighting men out in such ships.

Would not these navies possess a great advantage on this account?

How could our admiral "find the enemy," and destroy him when the enemy, by means of their dreadnought cruisers, would be able to keep in touch with the movements of our fleet, while our admiral would be in the dark?

Ought not our next two ships to be of the "Lion" type, or at least one of them?

A. B. IRVINE.

St. Marc, Haiti.

[Our correspondent has placed his hand on a weak spot in the make-up of our fleet. For some years to come our annual naval programme should call for two battleships and two armored cruisers of the "Von der Tann" type. Our "Chesters" (25 knots) and "Washingtons" (21 knots) would be helpless in the presence of the 26 to 28-knot 12-inch gun armored cruisers of foreign navies. —ED.]

Foreign-built Dredgers Built to the Order of the United States

To the Editor of SCIENTIFIC AMERICAN:

There is announcement made that a Glasgow firm has just launched the United States dredger "Corozal," built to the order of the United States government.

The order was placed last August, and caused considerable dissatisfaction to United States builders. Only one Ameri-

Building Character in a Writing Machine

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can builder made tender, and it was so much higher than the foreign builders offered to build for, that President Taft felt justified in vetoing the resolution of Congress prohibiting work for the United States to be done in foreign yards. The difference between the foreign bid and the one bid tendered by the American company that bid, amounted to almost $100,000.

In other cases the government exercises its power and avails of foreign tonnage, rather than pay the American "scale" of freight charges. Annually several thousand tons of coal for the account of the government are transported from Virginia to San Francisco and Portland, Ore., foreign tonnage can be had to move it for sixty per cent of what the American-built tonnage charge. The government contracts with the foreign tonnage, and the coal is moved on the low rate.

If an American company has coal to move from an Atlantic American port to an American Pacific port, it is compelled to use American tonnage and to pay the American freight scale.

The government of the United States refuses to obey its own laws. The United States government shows that the navigation laws tend to extortion. The United States government compels the people of the United States to obey the navigation laws and to pay extortionate freight rates.

Is it not time to consider the revision of these navigation laws, that have been in effect for over one hundred years, and which have practically driven us out of the foreign shipping trade and been the means of extortion and monopoly in the domestic? If the government of the United States refuses to obey its navigation laws, why should the citizens of the United States be compelled to?

There is a remedy for this state of things; allow American registration for foreign-built American-owned tonnage, limited if necessary to foreign trade, and put all iron and steel and shipbuilding material on the free list. We will then be able to compete in building with foreign yards.

As long as iron and steel are highly protected, and as long as iron and steel made in this country is sold from $8 to $11 per ton cheaper to foreigners than to our home builders, we will be unable to meet the competition of foreign builders of tonnage.

There is depression in United States trade. Many of our yards are on short time. We want a revival of our American merchant marine. The surest way to bring it about is to reform the navigation laws, and allow Americans the privilege of "free ships" the same as Great Britain and Germany allow to their people.

Also we should break the monopoly that exists in the iron and steel trades by taking off all duties.

Chicago, Ill. CHARLES DEPESEE.

General Factory and Machine Shop Lubrication

IT is a matter of common knowledge among well informed factory managers that the power loss due to the friction developed in the moving parts of machinery, is considerable. In the endeavor to reduce this absorption of power experiments have been and are being made with types of roller and ball bearings. Lubrication, however, is a question just as important. As a consequence of the failure to appreciate the necessity for the investigation of lubricating problems and choice of lubricants, the possible saving in this direction is frequently very large.

A considerable reduction in power can usually be effected by simply changing the oil. These reductions will in many cases be approximately the same as the substitution of roller or ball bearings for the ordinary type of bearing. This being the case, it seems advisable to consider the elements bearing upon efficient lubrication in a practical way and the necessities for the right quality of oil in the right place.

When reductions in power to the extent of ten or fifteen per cent in the driving of workshop machinery and shafting are easily brought about by the re-establishment of oils or the use of more suitable lubricants, and when this reduction of power can in many cases be brought to

The Warner Is the Official Road Map Speed Indicator

THE WARNER was used in compiling the routes in the Automobile Blue Book, King's Official Road Guide and the dozens of Official Guides put out by Automobile Clubs and map makers.

Note how this affects *you*—

You tour unknown territory occasionally. You must depend on some reliable map or ask your way at frequent intervals with unsatisfactory results. Some people delight in directing Automobilists to take the worst roads or the wrong road.

With the Warner Auto-Meter on your car the road map directions are easy to follow. It is impossible to go wrong. Where the route book says: "21.6 miles—four corners. Turn right at country schoolhouse; bridge over creek ¼ mile away"—you will find the four corners and the schoolhouse just when the route book says—at 21.6 miles, no more and no less.

Note this little human interest story which bears on this point.

Early in June a car drove up to our Beloit factory. It bore an Ohio license number. The owner was driving. With him were his wife and two daughters. One of the first things he said, after introductions and greetings were over, was: "I had only had my car a week when we decided to drive from Columbus to Madison, my old home, in the auto. And do you know we *haven't yet asked a direction from a single human being*, relying entirely on our route book." The directions came out right because the routes were surveyed—and interpreted—by Warner Auto-Meter.

This case is only one of many which have come to our notice.

There are conditions when touring becomes a nightmare instead of a pleasure.

The different route book and map makers have themselves advertised the fact that the Warner was adopted by them as their "Official Speed Indicator," because after testing all makes they found the Warner in every sense the sensitive, accurate, dependable and reliable instrument of precision we have claimed it to be.

When an *inaccurate* and unreliable speed indicator is used to interpret an *accurately* surveyed map or route, disaster results.

In such cases where the route book says: "49.8—forks in road with big elm in angle. Take the left branch." You are likely to find nothing in sight but open prairie or you may be approaching a four corners or small town. So you are *lost* unless you stop to ask questions, and this is what a route book is intended to prevent.

The route book maker's principal tribulation is explaining to owners of unreliable speed indicators that their routes, compiled at a cost of thousands of dollars, are *right* and that no one using a Warner speed indicator to interpret them has cause to complain.

A little Warner device which adds still further to the joys of Touring.

All Warner instruments of the dial type (see illustration) have two resetting buttons for the trip mileage figures. One resets the figures to 000.0 with a single turn. The other works on the tenths of a mile only, making it possible to turn up any desired mileage on the trip scale. This makes it possible to drive around the boulevards or through the parks at any point and then in a few seconds set the mileage back to correspond with the route book readings. Those who tour regularly will appreciate this refinement.

The Warner costs more than inferior speed indicators for a very good reason.

Those who look for satisfaction on the bargain counter are certain to be disappointed. We have all had our lesson. Supreme quality is worth its cost. And—as in other things—the Warner is also the *cheapest* speed indicator obtainable if you base its price on *years of service* or *miles of travel*. It is a permanent investment because it remains as sensitive, accurate and reliable as when new for many years—or many hundred thousand miles.

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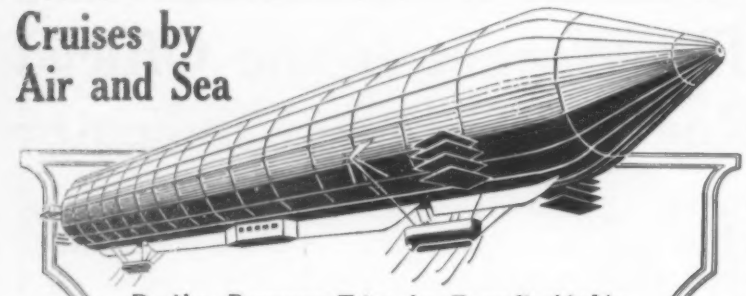

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Cruise to South America by S. S. Bluecher (12500 Tons) leaving New York Jan. 20, 1912. Duration 80 Days. Cost $350 and up.

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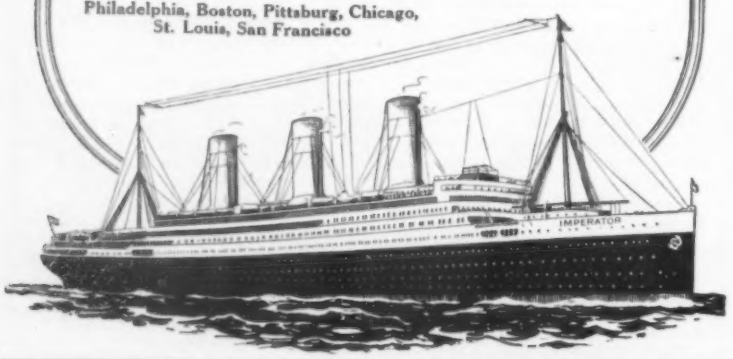

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But that isn't all. That bit of soft B & B wax gently loosens the corn. In two days the corn comes out. No pain, no soreness, no inconvenience—no feeling whatever. The callous simply separates itself from the toe, and the trouble ends.

Five million corns annually are removed in this way—removed by Blue-jay plasters. Get a package—end yours, too. Don't temporize with corns.

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D is rubber adhesive to fasten the plaster on.

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as high as thirty or forty per cent, it is very evident that the investigation of this subject is worth considerable time and trouble.

Because a good quality of oil is bought by the purchasing agent of a company it is not always true that this oil is used to the best advantage in the works. As an example: If an oil similar to a high class dynamo oil is bought by the purchasing agent in large quantities for a general machine shop and, as frequently happens, a considerable portion of this oil is mixed with either cylinder or black oil—to suit the operator's idea of what he imagines is the proper compound for general lubrication of machinery—the mixture is not at all adapted to the work which it is made to perform; and (if the original oil is being mixed with cylinder oil, as is sometimes the case) the cost is greatly in excess of what it should be, and the efficiency of the oil as a general lubricant is considerably impaired, even though the cost has been increased.

It is impossible here to make any statement as to the use of different classes of lubricants for certain purposes, as the conditions of speed, pressure, class and arrangement of machinery, the devices employed for the lubricating, etc., have considerable effect, not only upon the oil which can be used but upon the character of oil which is most efficient for the work.

It may be stated, however, that the use of light oils is possible only where special mechanical devices are arranged for the purpose of lubrication or where the shafting has the proper ring oiling bearings, etc. It is also true, as a rule, that floor machinery cannot be lubricated satisfactorily with the same oil that is used for modern shafting. Floor machinery itself can very well be divided into three classes, each class being lubricated with a different oil.

In the lubricating of plants of a general character it is customary to use grease or solid lubricants for some purposes. In some cases greases can be used with economy, but an excess of grease will act against the actual economy of operation on account of the increase in power required to overcome friction of the parts where the grease is used. It is invariably the case that grease will require the development of more power than necessary where oil is being used, and the only features that commend grease as a lubricant are its greater cleanliness and the fact that less attention is required in the lubrication of the various units.

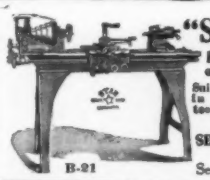
Where bearings have some mechanical fault of construction or alignment, or are roughly fitted, or where it is not worth while to produce a proper fit, they absolutely require grease as a lubricant; but even under these conditions such bearings can be lubricated in some cases more cheaply by the application of heavy cylinder oil.

In considering the efficiency of lubricants for general purposes, the fact that grease will reduce the bearing temperature of an improperly constructed or mechanically imperfect bearing should not be taken as indication that the same results will obtain from the use of grease through the entire plant, where probably almost every other bearing is in good condition.

It is very frequently the case, however, that grease is placed in a shop for general lubrication on account of just such a misconception from its work upon an imperfect bearing, the imperfections in the bearing not being taken into consideration. The fact of the matter is that the reduction of the temperature in this case which follows the use of grease in the bearing is the result of a special condition and does not illustrate the general applicability of the material.

The amount of oil required to provide proper lubrication in order to reduce the friction loss as nearly as possible to a minimum is so small that if it were possible thus to reduce the amount used the oil accounts of every company would be cut in half and in a number of cases possibly a large reduction would be undertaken.

The high oil accounts as a rule are due to the waste of oil. In order to reduce this waste and bring it down to a proper proportion of the amount of oil necessary for the lubrication of the machinery, etc., it is absolutely necessary that appliances should be installed which will enable the



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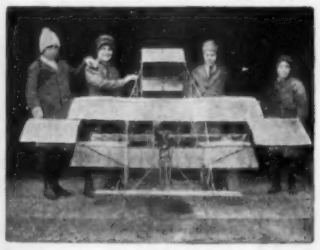

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proper care to be exercised in the use of lubricants.

The installation of the gravity feed system, of appliances for catching the waste oil as it comes from the bearings, etc., so that this oil can be cleaned and re-used, the use of ring oiling bearings, pad lubricators, sight feed pressure pumps and pressure lubricators are all necessary for the elimination of the waste of oil and the consequent reduction in the amount paid out on account of lubrication.

If the gravity feed system be employed, the oil can be used indefinitely, and, besides the economy secured from the re-use of the oil, additional power economy is obtained from the fact that a large amount of oil can be used by flooding the bearing and consequently securing a good free film of oil between the surfaces which assist in the efficient lubrication and reduction of temperatures.

All devices which are installed for the purpose of saving otherwise waste oil require that the oil used for lubrication shall be excellent in quality. A poor quality of oil will not stand continuous use without entirely breaking down and consequently defeating the very purpose for which it is to be used—that is, the reduction of loss by friction.

A great many shops, while they are heated during the working hours in winter, are apt to become cold during the night, and in order to provide efficient lubrication under these conditions the oil should be of such a character that it will remain fluid during cold temperatures. Under these conditions it is necessary that the oil shall have a (low) cold test, of at least 25 degrees above zero, in order that the lubrication be effective.

The science of lubrication is a very intricate one and the problems to be handled are so many and varied, involving as they do the mechanical conditions of the plant, the physical and chemical characteristics of the oil and the partly physical and partly chemical action arising from the conditions under which they work, that it is impossible to do more than state these one or two general points in an article of this kind. In fact it is necessary for effective lubrication that this matter should be handled by a man who is expert in both the theory and practice of the science, otherwise even the most effective devices employed for the purpose of saving the waste oil and allowing efficient lubrication will be of little avail in the actual reduction of lost power by friction.

Practically the only people who have had a large and varied experience in the science of lubrication are the experts employed by the large oil manufacturing companies who have had the opportunity of gathering data regarding the conditions presented in practically all the variations possible, and are therefore constantly accumulating information showing that the systematic and careful study of lubrication has resulted in a reduction of the lost power and consequent expense in the operation of machinery, and in further reductions in the amount of oil used; to the benefit of users of power of all kinds; and in addition to this fact such a study has resulted in the production of oils better suited for the purpose of lubrication from a manufacturer's standpoint, so that the continual tendency is to provide possibilities of further reduction of the loss due to friction in moving parts of the machinery and other apparatus.

The Business Side of Aviation

(*Concluded from page 337.*)

a novelty and are rapidly becoming a necessity. Even special clothing for aviators is now being made, leather being a favorite material. Numerous kinds of map cases, portable buffets, helmets, searchlights, and horns are offered specially for aeroplaning.

There is also much done in France in the manufacture of instruments for aeronautical work, speedometers, recording barographs, altiscopes, sketching cases and specially mounted compasses.

Coincident with the large trade in aeroplane supplies and in aeroplanes themselves, there has arisen a large number of firms in France, acting as aeroplane brokers, receiving orders and transmitting them to the manufacturers. Dealers in second-hand machines and supplies are also springing up, but their field is

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Forestry Cloth (Shade No. 65) is a unique fabric, made by us exclusively, for men's and women's wear, for such special uses as camping, fishing, golfing, mountain climbing clothing. It is made of *highest grade, strictly pure, all wool worsted*—which experienced sportsmen know is the only material entirely satisfactory for outdoor garments.

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Olivauto Cloth (a fabric similar to the above in weave) is made in an attractive shade of light brown, and is especially suited for riding and driving clothes, motorists' apparel, outing suits and raincoats.

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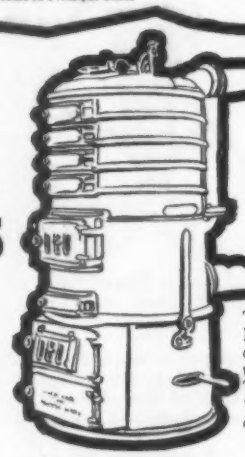

There is a Pierce Boiler exactly suited to your needs. This is the "Spence" one of 200 styles

still very limited—a second-hand aeroplane is a dangerous investment at best.

Even the profession of the law is called into the aeroplane field to a great extent the number of flourishing patent attorneys giving an indication of the amazing number of patents applied for.

The model aeroplane also plays its part in the industry and many model manufacturers sell several hundred of these toys at prices ranging from $1.50 to $20. Gliders, motorless aeroplanes, are also manufactured and sold, especially in England, where "gliding" is becoming a hobby.

The number of corporations applying for certificates in various States, although only a few survive, gives a further indication of how active the field of aviation is becoming from the business side.

The Art.

It is not only in the trade and manufacturing of aeroplanes that a large volume of business is found. Activity of another kind, but of equally great importance exists in the cultivation and practice of the art of flying.

A large number of men are employed by private individuals to fly their machines for them, and many manufacturers have a regular staff of expert birdmen to test, exhibit and instruct others on their machines.

Few persons appreciate the actual cost of flying and what it means to keep as delicate a machine as an aeroplane in perfect order. Atwood in his great St. Louis-New York trip, is said to have made over $6,000 in prize money. It is understood on good authority that this failed by a large margin to pay his expenses.

To keep an aeroplane in perfect trim two or three trained mechanics are required. The wages of these men are $30 to $35 a week each, and often more.

A Burgess-Wright aeroplane of the kind used by Atwood requires four gallons of gasoline an hour in flight, the gasoline costing about 20 cents a gallon. Oil, motor accessories, spare spark plugs, etc., also cost a considerable amount. The aeroplane, itself, practically used up in this grueling campaign, cost $5,000.

In addition Atwood has large expenses for rents of fields and hangars, as well as damages to property, and in his own traveling expenses, his manager's salary, etc., are found other sources of expenditure. The grand total amounts to well over $8,000—a rather expensive way to travel.

At the recent aviation meets many of the contestants suffered heavy financial losses. In most cases, however, the losses fall on the manufacturer who supplies the machine and who employs an expert to handle it.

The earnings of some of the aviators at the recent Boston meet are: Ovington, $11,782; Milling, $6,200; Sopwith, $6,022; Grahame-White, $5,224, etc., down to Ely, $150; and others with no winnings at all.

At Nassau, Sopwith won $4,850, while Atwood and Lieut. Arnold won only a few hundred dollars.

There are other sources of revenue, however, in the actual flying of aeroplanes.

Passenger carrying at $25 to $50 a head is becoming customary in this country. In England and France, regulation booking offices have been opened where reservation can be made. The price is from $10 upward.

Manufacturers and aviators also make a considerable charge for instruction of pupils. In France, $150 is the usual price for a full course. If breakages are to be included, the Voisin Company charges $500.

At many aerodromes in England, where their location seems to be definite, hangars and the privileges of the field may be rented at $500 a year. The rent of the hangars in France is about the same.

The business of aviation is thus growing apace and the possibilities that are offered in the flying field for the development of industrial enterprises can probably be as little conceived of at present, as could the future of railroading one hundred years ago.

A Landsman's Log

(Concluded from page 345.)

row, until, in the case of vessels such as the "Michigan," which carries a lofty

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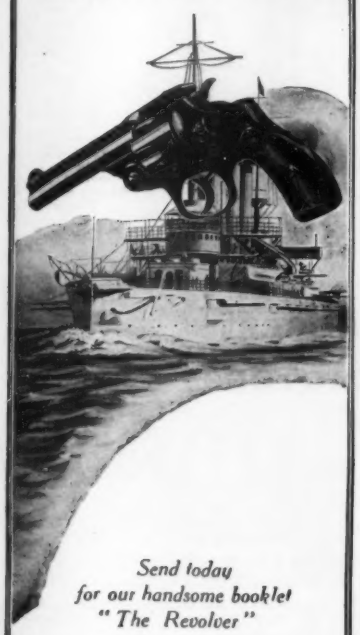

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superstructure, the effect is that of a many-storied hotel. Ship beyond ship, over miles of water, stretches this floating city of twelve thousand souls. The thousands of incandescent lights become millions as they are reflected from the ever-restless water of the Chesapeake, emulating in numbers and beauty the flashing myriads in the over-arching dome of the autumnal night.

The "stern realities of war" seem very far removed, as I drink in the quiet beauty of the scene and catch the strains of well-remembered music faintly heard from a band on some distant ship. The mood was deepened when a message came to the captain and the ward-room mess that night, inviting the officers to a moving-picture show—of all things in the world! But there it was; the screen hung between a 12-inch turret and the whaleboat davits; the machine at the taffrail; the crew crowded picturesquely on one side of the screen, the officers seated forward on the opposite side. It was an audience that in size would have comfortably filled an average theater; for decorum it would have matched any house on Broadway. The pictures were largely reminiscent of those western plains and mountains from which so many of these fine young sailormen had come. Certainly there was nothing to conjure up in that quiet hour the sights or sounds of war—and yet—once—the glint of the lantern light flashed along a pair of 12-inch rifles that stretched their black forty-five feet of length ominously above the screen. "Yes," I thought, "these are perfectly consistent with the restful scene that flickers on the canvas below. Guardians of the peace they are—pledges that 90 millions of people, peace-loving and prosperous, are determined that their peace and prosperity shall endure through the years to come, unbroken and unassailed!

An Opportunity for the Farmer in the United States

THE profitable cultivation of basket willow in the United States is an opportunity that should not be overlooked by farmers who are anxious to add to their income by the cultivation of a crop on land that is now lying idle. Basket willow, like a number of other farm crops, is one of the smaller opportunities so often lost sight of in the general desire to grow crops on a large scale with the thought that there will be corresponding large returns. American farmers are apt to overlook the combined results from many small crops that can be handled with comparatively small expense. European farmers keep a strict account of these, and in the aggregate often reap a rich reward for their thrift.

The demand for basket willow as an article for manufacturing basket ware and furniture is constantly growing. In this connection it is interesting to know that the United States is a very large purchaser of basket willow rods from France, Germany, Holland, Belgium, and Austria, while there are millions of acres of waste or undeveloped lands in this country capable of producing enough basket willows to supply the world. There is an annual importation of approximately one million pounds of basket willow rods ready for the basket-makers' use. Approximately four times this amount is imported in the form of manufactured basket ware and willow furniture. The total value of this material is about $300,000, which might as well be paid to the American farmers if they knew how to grow the crop successfully.

That the growing of basket willows is a profitable farm crop may be seen from the figures of yield contained in a United States Forest Service circular entitled "Practical Results in Basket Willow Culture." An acre of well-managed basket willows, calculating the yield at 3,000 pounds of dry sap-peeled rods at 5 to 7 cents a pound, will give a net profit of from $75 to $135 per acre. The cost of cultivating and harvesting basket willows is variously estimated at from $50 to $75 an acre. Of course the above figure of yield is above the average for the United States, but even if the crop should be only two-thirds of that obtained on the experimental farm at Arkington, Virginia, the net profit would still be far better than that of most other farm crops.

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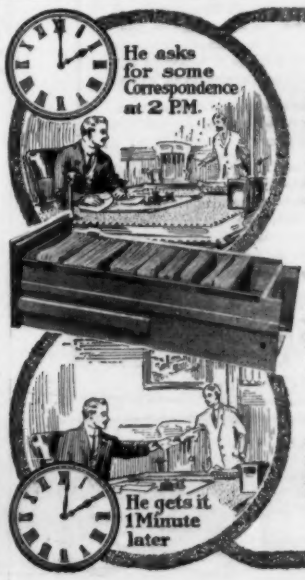

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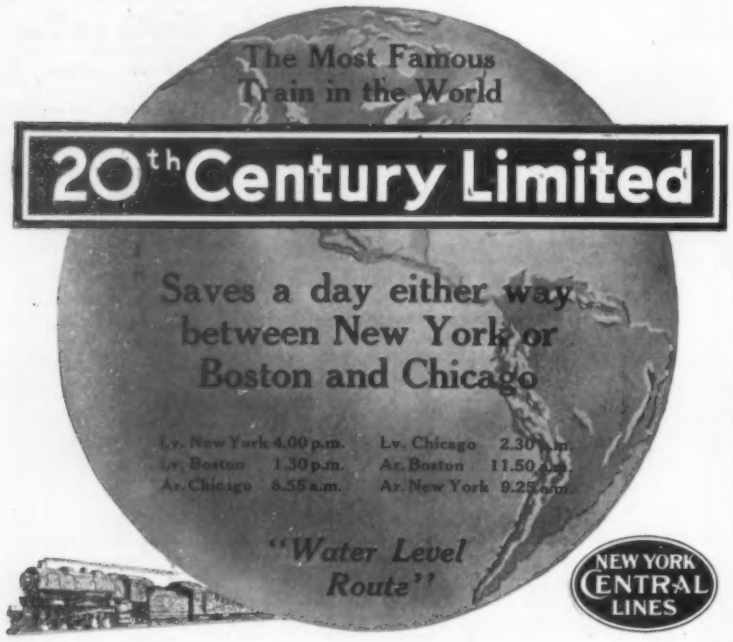
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At the International Municipal Congress and Exposition, Chicago, September 29th, *Edward F. Croker, Ex-Chief of New York City's Fire Dept. who spent 27 years in the service, 12 years as chief, said:*

"IF we are to better conditions, we must realize that 'fireproof' is not 'fireproof' as it is understood today. The literal definition remains, but many crimes have been committed in its name. . . There is but one principle to fireproof construction irrespective of the kind of structure. To have fireproof buildings, architects and owners must throw aside precedence and eliminate the use of combustible and semi-combustible materials in their construction.

" . . . . If there were still an absolute necessity for its use, if it could not be replaced with steel, as it has been in many modern constructions, it would then be well to attempt to conceive of something better. I am opposed to the use of wood in any form in fireproof buildings and the law ought not to permit its use.

" . . . . To me there is a fascination about steel interiors. It constantly emphasizes the absurdity of fire-fighting, for how can fires rage if they have nothing to feed upon?"

Interviewed, Ex-Fire Chief Croker said: "You are at perfect liberty to use my talk partially or entirely and apply it to your products. I have watched your development since you first originated cold drawn steel interiors with great interest. I have nothing more to say. My address and the fact that my private residence will be equipped throughout with The Dahlstrom Products is as strong a recommendation as I can make."

Ex-Fire Chief Croker's address has been done in booklet form. Copies may be had for the asking. "Buildings As They Should Be" clearly describes the elimination of all combustible materials in buildings. A copy may be had for the asking. 6 cents. Stamps for it.

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Notes and Queries.

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(12548) C. A. E. H. says: I have seen it stated that the mouths of some rivers are higher than their sources. I can see that this may be true of rivers such as the Mississippi, which flow toward the equator through a number of degrees of latitude. If the water is actually farther from the center of the earth at the mouth, will you kindly explain the force or forces acting upon it to raise it? A. All rivers which flow south in the northern hemisphere, or north in the southern hemisphere, are farther from the center of the earth at their mouths than at their sources. The earth's diameter is 26 miles longer through the equator than it is from pole to pole. The theory is that the earth was once soft, and in rotation, and bulged at the equator by centrifugal force. The earth has cooled and become solid, but the centrifugal force remains. The yielding water takes the position which the rotation of the earth requires it to take. The very definition of a level surface is one which is parallel to the surface of still water. The Mississippi River flowing south does not take this position. It is below that position at its mouth. It really flows down to the Gulf of Mexico, although in so doing it goes farther from the earth's center. The name of the force raising it farther from the center of the earth is "Centrifugal Force."

(12549) A. J. I. says: Kindly settle the following argument for me: A friend of mine contends that after water has assumed the solid state as ice, provided the pressure is constant, its temperature will remain at 30 deg. F. so long as the temperature of the surrounding medium remains below 32 deg. F., and that if the surrounding medium was to go down to 8 deg. F., the temperature of the ice would remain constant. I contend that the temperature of the ice varies with the temperature of the surrounding medium, as also does its volume. A. Water, in the solid state, is no different from any other solid. All solids rise and fall in temperature as the place in which they are is heated or cooled. Everybody knows that ice cream, which is largely frozen water, is cooled much below the freezing point and packed to make it keep. Ice also expands and contracts by heating and cooling, just as iron or any other solid does. People are misled by the fact that ice cannot be heated much above 32 deg. Fahr. It melts, but so does every other crystalline solid when it is heated to its melting point. All such substances cannot be heated above the melting point any more than ice can. The peculiarity of ice is that it melts at a very low temperature. Most crystals melt at a much higher temperature than does ice. Ice when below 32 deg. becomes dry. It is easy to see the difference between ice in cold air and ice in warm air. The writer has cooled ice to the temperature of liquid air, more than 300 deg. Fahr. below zero. It crumbled into very small pieces by its contraction at that temperature.

(12550) A. F. H. asks: Will you please explain through Notes and Queries, the following terms as applied to steel rails: Horizontal Inertia, Vertical Inertia, Moment of Inertia, Section Modulus, Radius of Gyration? A. Consult one of the books on mechanics, such as Merriman's "Mechanics of Materials," ($5 if ordered from our Book Department), for a full explanation. Briefly, "moment of inertia" is a term signifying the sum of the masses of the particles of a body, each multiplied by the square of its distance from the center of inertia, which may be a point or an axis. In the rail section herewith, the sum of the masses of the particles multiplied by their distances squared, would be the polar moment of inertia if all the distances ran together at

the crossing of the axes; or the moment of inertia about the horizontal axis, if the distances all ran vertically to the horizontal line *AA;* or the moment about the vertical axis, if the distances ran perpendicular to that axis. The section modulus is the moment of inertia divided by the distance of the most distant particle from the pole or the axis of inertia. Its value, like the values of the moment of inertia, may be found in the pocketbooks, for all standard rail sections. The radius of gyration is the distance from the pole or the axis (as the case may be) of inertia to that point at which, if all the mass of the body were concentrated, the moment of inertia would be the same as for the original shape.

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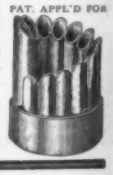

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NEW BOOKS, ETC.

PRINCIPLES OF PHYSICS. By William Francis Magie, Ph.D., Henry Professor of Physics in Princeton University. New York: The Century Company, 1911. 570 pp.

The author's name is sufficient guarantee for the general excellence of the book before us. It is very remarkable how much information has been condensed into a volume so small, considering the boundless scope of the subject. Moreover, the information is thoroughly up-to-date. In turning over the pages we have found the Brownian movement and Perrin's recent work duly considered in their relation to the kinetic theory. Similarly the chapter on "Electricity and Matter" presents in simple but clear terms some of the fundamental facts upon which the modern views on the subject are based. A brief note is also devoted to the phenomenon of radioactivity. There is little criticism to offer. The opening paragraph of the first chapter attempts a definition or description of "physics," and can hardly be said to be quite successful. There are some things that can not be rigorously defined, and probably the scope of physics is such. One is almost tempted to say that "physics" is all science which has not been for one reason or another (not necessarily a very good reason) been given some other name—and even that may be physics. One can not help regretting that it should be necessary or desirable in a book of this kind to avoid the use of the calculus, often at the cost of much complication. So much can be done in elementary physics with a small stock in trade of the methods of the calculus, that it would seem well worth the while to arrange the student's courses in mathematics in such manner as to avoid the necessity of working out from first principles every case of "proceeding to a limit." In the development of the absolute temperature scale, the ideal gas is introduced as a "guide" for the choice of the temperature function which shall enter into the expression for the efficiency of a heat engine. It appears preferable to develop this function without reference to any specific properties of the working substance. Making use of an "ideal gas" (which does not exist) gives an appearance of unreality to the argument, and is apt to leave in the mind of the young student an impression that the argument in some way depends on the properties of the "ideal gas," whereas what one is particularly anxious to impress upon the learner is the fact that the efficiency is wholly independent of the properties of the working substance. The general scope and arrangement of the book may be gathered from the main headings, which are as follows: Book I—Mechanics. 1. General Notions About Forces. 2. Statics. 3. Dynamics. 4. Mechanics of Liquids. Book II—General Properties of Matter. 5. Gravitation or Mass Attraction. 6. Elasticity. 7. Capillarity. 8. Gases. 9. Friction. 10. Diffusion. Book III—Sound. 11. Sound and Sound Waves. 12. Sounding Bodies. Book IV—Heat. 13. Temperature and Heat. 14. Thermal Relations of Bodies. 15. Heat and Energy. Book V—Light. 16. Geometrical Optics. 17. Physical Optics. Book VI—Magnetism and Electricity. 18. Magnetism. 19. Static Electricity. 20. The Electric Current. 21. Electricity and the Ether. 22. Electricity and Matter.

BUNGALOWS. Their Design, Construction, and Furnishing. With Suggestions also for Camps, Summer Homes, and Cottages of Similar Character. By Henry H. Saylor. Philadelphia: The John C. Winston Company. 4to.; 188 pp.; illustrated. Price, $1.50 net.

Bungalows, springing up mushroom fashion all over the land, have imparted a not unpleasing variety to our countryside architecture. Mr. Saylor's papers are aptly introduced by Burgess Johnson's "Bungal-Ode." The advantages and limitations of the true bungalow are impartially set forth, and under the heading "Types" we are given, in beautiful plates and succinct description, more than a score of houses scattered from the Atlantic to the Pacific coast. Bungalows for seacoast, woods, and hills are given separate consideration, and chapters on "Plan," "Foundations," "Walls," "Roofing," and "Interior Finish" tell what the prospective builder needs to know. Even the fireplace, furnishings, lighting system, water supply and sewage disposal are treated at some length, and the setting of flowers, vines and shrubs, an important matter from an artistic point of view, is the subject of a final chapter. The large pages, fine paper, clear plates and good printing make the book a desirable one to own, and the common-sense manner in which the author presents his knowledge and advice places the seal of practical value upon what would still be a work of beauty and suggestive inspiration even without so informing a text.

PRACTICAL SILO CONSTRUCTION. By A. A. Houghton. New York: The Norman W. Henley Publishing Company, 1911. 69 pp.; 20 illustrations. Price, 50 cents.

We have before taken the opportunity to mention favorably the earlier issues of these "Concrete Worker's Reference Books." The treatise in hand, No. 3 of the series, comprises directions for constructing concrete silos of various types. Full data and working drawings are given, and unpatented forms and molds are shown for the building of monolithic and block silos.

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Aeronautics

Death of Edouard Nieuport.—M. Nieuport, the builder of the fastest monoplane in the world, died from a fall sustained on the 15th ult. An account of his and other fatal accidents, together with a description of his monoplane, appears in the current SUPPLEMENT.

Helen's Record for the Michelin Trophy.—Emmanuel Helen, on a Nieuport monoplane, flew 1,252.8 kilometers around a 104.4-kilometer circuit on the 8th ult., in France. Deducting from his total time—14:07:50—the six stops he made, his time in flight was 13 hours and 17 minutes—an average speed of 58.6 miles an hour. His previous record of August 26th was 700 miles in 13:47:19.

The Aviation Meet at Nassau Boulevard.—The international aviation meet on Long Island was successful, and resulted in several new records. Chief of these was the record of endurance with two passengers, which was raised from the 1 hour 38 minutes 40 seconds made by Mamet at Rheims in 1910, to 1 hour 54 minutes 22 2/5 seconds. The new record was made by Lieut. Milling, in his Wright biplane, and in making it he also won a prize of $1,000 offered by the Hotel Knickerbocker for 100 minutes in the air with two passengers. The best previous American record, made by Beatty at the Chicago meet, was 1 hour 18 minutes 22 seconds. Besides races between Sopwith, on a Blériot, and Grahame-White, on his Nieuport, exhibition flights were made by Dyott on two Deperdussin monoplanes and also by Mlle. Helene Dutrieu, on her "baby" Farman biplane. Miss Matilde Moisant outflew Mlle. Dutrieu by soaring to a great height in her Moisant monoplane, and flying far across country, while Miss Harriet Quimby made a record cross-country flight in 39 minutes, ascending to a height of 2,500 feet.

The Transcontinental Flight.—After delays of three or four days, owing to breakages and unfavorable weather conditions, the two aviators who attempted to cross the continent in opposite directions in Wright biplanes—Robert B. Fowler and Calbraith P. Rodgers—finally resumed the flight on September 28th. Fowler had twice previously tried to scale the Sierras, but without success. In one of these attempts he experienced difficulty in climbing to the necessary elevation, while in the second one, after attaining a height of nearly 7,000 feet and getting to a point within 15 miles of the summit, his motor stopped and he was obliged to glide back to a suitable landing place. He alighted at Emigrant Gap. His third attempt, on the 28th ult., resulted in reaching an altitude of but 1,500 feet on account of choppy cross currents of 20 miles an hour or more which drove him back to earth after a 20-minute flight. After this experience Fowler abandoned the race.

Rodgers's Progress in the Flight Across the Continent.—Rodgers's machine was so badly damaged by contact with a barbed-wire fence on the 24th ult. that nearly four days were required to repair it. He left Red House, N. Y. (where the accident occurred) at 10:35 A. M. on September 28th and alighted on the race track at Meadville, Pa., at 12:30 P. M., after having covered the 104 miles from Salamanca to Meadville in 106 minutes. This included circling the former town and hovering above Meadville at a 3,000-foot elevation for several minutes in an endeavor to locate the Country Club. About 10½ gallons of gasoline were consumed on the trip. A fresh start was made at 1:20 P. M. but the aviator was obliged to alight shortly after at Warren, O., on account of the oil tank not having been filled by his mechanics. A skid was broken by a concealed ditch and it was 4:30 P. M. before he set out for Akron. He covered 30 miles to Kent, a small place some 10 miles from Akron, in 40 minutes and was able to alight successfully in a field which he was barely able to discern on account of darkness setting in. He covered 204 miles altogether. During the next four days he made some progress and reached Huntington, Ind., 142 miles from Chicago. In starting on October 3rd, a down current drove him to the ground and smashed his machine once more. On the 5th he resumed the flight and covered 123 miles to Hammond, Ind.

Science

Constituents of the Body.—Our body may be said to weigh about 70 kilograms, or say 154 pounds average, the various constituents being as follows:

	Kg.	Lbs. av.	Per cent.
Muscles	30.4	67.02	43.5
Fat	13.3	29.32	19.0
Skin	12.4	27.34	17.8
Bones	12.2	26.90	17.5
Brain	1.5	3.31	2.2
	69.8	153.89	100.0

There are 45 liters = 45 kilograms or 99 pounds average of water and 25 kilograms = 55 pounds of solid matter; the latter being composed of 14 kilograms = 30.8 pounds of albumen, 7 kilograms or 15.4 pounds of fat, 3½ kilograms or 7.7 pounds of salts, and 0.7 kilograms, or 1.54 pounds of sugar.

The Work of the Human Heart.—The average human heart is a suction and force pump of remarkable capacity and durability. Each of its two chambers contains, on an average, 75 cubic centimeters or 4.575 cubic inches; the total contents of 150 cubic centimeters or 9.15 cubic inches being discharged 81 times a minute, corresponding to a delivery of 12,150 cubic centimeters (12.15 liters) or 741 cubic inches per minute, 729 liters or 25.73 cubic feet per hour. Expressed in U. S. gallons, the average human heart pumps through it each hour 192.6 gallons; each day, 4,622.4 gallons; each year 1,687,176 gallons; and in the adult life time of a man living to the age sung by the Psalmist 8,435,880 gallons. The pressure against which this fluid is pumped is equivalent to that of a water-column 2¼ meters or say 8 feet 2.42 inches high; otherwise expressed, about 0.242 atmospheres or 3.55 pounds avoirdupois per square inch.

Strength of Human Bone.—Fortunately the human skull, although composed of bones is elastic—much more so than one would think. The average male adult skull, in fact, is so elastic that it may be compressed laterally in diameter by a blow or by pressure, applied at the center of area, at right angles to the surface at that point, by 1½ centimeter or about six-tenths of an inch; recovering its original diameter and form, without breakage. The material of which our bones are made is so highly resistant that a cylindrical piece thereof only one square millimeter or 0.00155 square inch in area (i. e., only 1.128 millimeter or 0.044 inch in diameter) has a tensile strength of 15 kilograms or 33 pounds avoirdupois, figuring out at about 21,300 pounds per square inch. A similar sample of hard wood tested in the same manner held only 10 kilograms—that is, bone has 50 per cent more tensile strength than wood. A single bone fiber is shown in the Hygiene Exhibition, Dresden, supporting a weight of 5 kilograms or 11 pounds avoirdupois.

Change in the Habits of Wild Rabbits.—German natural historical periodicals are calling attention to an interesting change in the habits of wild rabbits, especially in the western parts of Germany, as for instance, Westfalen. The animals in question are giving up their ancient habit of burrowing, and have commenced in great part to imitate the hares, which, as is well known, nest only above ground. The hares themselves were once burrowers, and gradually went through the same change in habits in this particular that appears to characterize the rabbits at the present day—at any rate in Germany. In woods where the undergrowth is thick, and which are therefore especially suitable to the rabbits, they find hiding places in plenty for their nests; and even in open country, unwooded—and the rabbits seems to be taking more and more to the open—they take refuge in board-piles, rubbish-heaps, brush-piles, brick-kilns, drain-pipes, and ditches that are overgrown with weeds. The female makes little fortresses for her young, to protect them from the cannibalistic propensities of the male; she lines the nest warmly with fur from her own breast, visits them secretly at night, and perhaps suckles them once more during the 24 hours; but each time that she leaves them she carefully piles rubbish before the opening which leads to her defenseless family, and defiles the obstructions with ordure.

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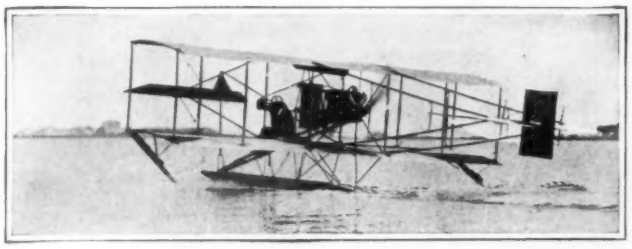

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It is a well known fact that to get the greatest economy it is necessary to use steam at a very low pressure, or better still at no pressure. In the *Broomell Vapor System* there is positively no pressure in the radiators, in fact there is a partial vacuum, and, as above stated, that, without any pumps, aspirators, mercury seals or mechanical devices whatever.

The *temperature* of each room can be *regulated at will.* The system is positively noiseless; it is very economical; no air valves are used; it has all the *advantages of steam heating* and *hot water heating* without any of their *many defects.* This wonderful system has been installed in thousands of fine homes and in hundreds of office buildings, churches, schools, hotels, etc., and has never failed to give the very greatest satisfaction. It saves the owner money—it saves the architect trouble—it saves the heating contractor responsibility.

If you want to know more about this plan of heating—*Broomell Vapor System* (there are many imitations) write to the Vapor Heating Company, North American Building, Philadelphia, Pa., J. D. Arnold, Manager. Vapor Heating Company, 1123 Broadway, New York City, Chas. E. Scott, Manager. Or to the Vapor Heating Company, York, Pa., A. P. Broomell, President.

You may ask "What has this to do with *Vacuum Cleaners?*"—and the answer is—that the same man who invented *Vapor Heating* is also the inventor and manufacturer of the *best and most complete Vacuum Cleaner* ever offered to the public. The Vacuum Cleaning business is run under the name of the VICTOR CLEANER COMPANY, works and main office at York, Pa. A. P. Broomell is the sole owner of the business.

VICTOR
Vacuum Cleaners

Are made in sizes and styles suitable for every service, and include Electric Portable, Electric Stationary, and a machine especially designed for the country home where electric current is not available.

THE VICTOR ELECTRIC PORTABLE

This is a very handsome, simple and durable machine. It can be operated from any lamp socket. It moves a large body of air and gives sufficient vacuum to thoroughly clean all kinds of carpets, rugs, furniture, etc. With this Portable, this "*sucker broom,*" there is furnished a full equipment of floor tools, brushes, etc., also 25 ft. of special electric wire, and 15 ft. of wire inserted vacuum hose.

The Victor Stationary for Country Homes. Almost every farmer and owner of a country home has one or more gasoline engines, or some available power, and we make a Vacuum Cleaner especially designed for use with such power. The Cleaner can be placed in the cellar of the house, or in any available out-building, *and a pipe run underground* to the house and connected to a riser, with vacuum hose connection on each floor. We furnish with this machine a combination cast iron pedestal, dust receptacle and dust separator, and on this is mounted a powerful rotary vacuum pump, which is driven from the gasoline engine or other available power. We have these machines in successful operation where the Cleaner is placed as much as *400 ft. away from the house.* The dirt is rapidly and completely removed from floors, carpet, etc., and delivered into the dust receptacle of the Cleaner. In many cases a pipe is run to the stable and *vacuum currycombs* used with great success on *horses and cows.*

THE VICTOR ELECTRIC STATIONARY VACUUM CLEANER

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